AREC 815: Experimental and Behavioral Economics

Contract Design when Agents Are Present-Biased

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Paying Not to Go to the Gym

Quasi-Hyperbolic Discounting

- Preferences at time t represented by the utility function

$$U^t = u(c_1) + \beta \sum_{\tau=t+1}^{\infty} \delta^{\tau-1} u(c_\tau)$$

where $\beta \in (0,1]$ and $\delta \in (0,1]$

- Let $\hat{\beta}$ denote beliefs about the future value of β
  - An individual is a **sophisticate** if $\hat{\beta} = \beta$
  - An individual is a **naif** if $\hat{\beta} = 1$
  - An individual is **partially naive** if $\beta < \hat{\beta} < 1$

Investment Goods vs. Leisure Goods

Investment goods:

- Immediate cost ($c > 0$), delayed benefit ($b > 0$)
- Examples: exercise, savings instruments, homework
- Will pay cost c whenever: $-c - p + db > 0$

Leisure goods:

- Immediate benefit ($b' > 0$), delayed cost ($c' > 0$)
- Examples: junk food, loans/credit, addictive goods
- Will pay cost c whenever: $b' - p - dc' > 0 \Leftrightarrow c' < (b' - p)/d$

Investment Goods vs. Leisure Goods

	Investment	Leisure
Long-run self "wants" to buy whenever...	$c \leq \delta b - p$	$c \leq (b' - p)/\delta$
Long-run self expects to buy whenever...	$c \leq \hat{\beta}\delta b - p$	$c \leq (b' - p)/\hat{\beta}\delta$
Short-run self actually buys whenever...	$c \leq \beta\delta b - p$	$c \leq (b' - p)/\beta\delta$

Investment Goods vs. Leisure Goods

Time inconsistency generates willingness to make upfront payments to alter marginal cost of investment, leisure facing future selves

- $1 - \hat{\beta}$: level of anticipated time inconsistency, determines willingness to pay for commitment devices
- $\hat{\beta} - \beta$: irrational expectations about future self, generates incorrect beliefs about consumer surplus resulting from contracts

Question: do firms anticipate, exploit these consumer characteristics?

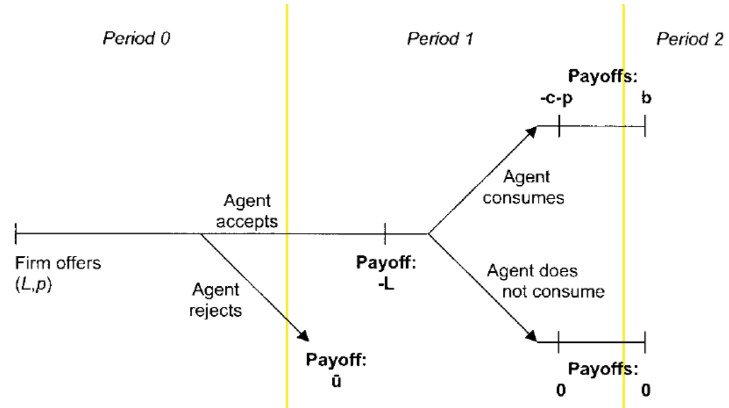
Paying Not to Go to the Gym

- DellaVigna and Malmendier (2004, 2006) survey 97 private health clubs in Boston area, collect attendance data from three large clubs
- Contract choices:
  - Monthly contract fee: $42
  - Pay-per-visit fee (no contract): $10
- Average visits by members with monthly contracts: 4
- 80 percent of clients with monthly contracts would be "better off" (i.e. they would pay less overall) on the pay-per-visit system
- Possible explanations:
  - WTP to lower marginal cost of working out ($\hat{\beta} < 1$)
  - Overconfidence about frequency of exercise ($\beta < \hat{\beta}$)

Monopoly Pricing

- Consider a monopolist offering a two-part tariff gym contract
  - L is the fixed "membership" fee
  - p is the per-visit charge
- Agent does not know her own "effort cost" of working out *ex ante*
  - Only knows distribution: c has CDF $F(c)$
- Agent chooses to either accept or reject contract before learning cost, chooses whether to go to the gym after learning effort cost

Monopoly Pricing



Monopoly Pricing

- If agent rejects contract, gets reservation utility $\bar{u}$
- If agent accepts contract, chooses action $a \in \{C, NC\}$
- Consuming entails effort cost $c > 0$, future benefit $b > 0$
- Agent's effort cost unknown at time $t = 0$:
  - c is a continuous random variable with pdf $f(c)$ and cdf $F(c)$
- TC consumer will go to the gym whenever $-c - p + \delta b$
- Agent goes to the gym with probability $\Pr(c < \delta b - p) = F(\delta b - p)$

Time Consistent Customers

- At $t = 0$, her expected net benefit from a contract is:

$$\delta\Big(-L + \int_{-\infty}^{\delta b - p} (\delta b - p - c) dF(c) \Big)$$

- She chooses the contract whenever:

$$\delta \bar{u} \leq \delta\Big(-L + \int_{-\infty}^{\delta b - p} (\delta b - p - c) dF(c) \Big)$$

or

$$L \leq \int_{-\infty}^{\delta b - p} (\delta b - p - c) dF(c) - \bar{u}$$

Present-Biased Customers

- At time $t = 0$, a quasi-hyperbolic agent
  - would like to go to the gym with probability $F(\delta b - p) \ldots$

    ...but expects to go with probability $F(\hat{\beta}\delta b - p)$

    ...and will actually go with probability $F(\beta\delta b - p)$
- Present-biased consumer chooses the contract whenever:

$$\beta\delta\bar{u} \leq \beta\delta\Big(-L + \int_{-\infty}^{\hat{\beta}\delta b - p} (\delta b - p - c) dF(c) \Big)$$

$$\Leftrightarrow L \leq \int_{-\infty}^{\hat{\beta}\delta b - p} (\delta b - p - c) dF(c) - \bar{u}$$

The Firm's Problem

- What does the firm do?
  - Fixed costs $K > 0$, variable costs $a > 0$
  - Firm anticipates consumer behavior, but doesn't know c
  - Knows consumer will only use gym with probability $F(\beta\delta b - p)$
- Firm's problem:

$$\mathrm{E}\left[\pi\left(L, p\right)\right] = \delta\left(L - K + \int_{-\infty}^{\beta\delta b - p} (p - a)\, dF(c)\right)$$

subject to consumer's individual rationality constraint

The Firm's Problem

- Re-arranging consumer's constraint tells us:

$$L^* = \int_{-\infty}^{\hat{\beta}\delta b - p} (\delta b - p - c) dF(c) - \bar{u}$$

since consumer will opt into contract only if it generates at least as much expected utility as she gets if she doesn't take contract, $\bar{u}$.

- The firm's problem: $\max_p \mathrm{E}\left[\pi\left(L, p\right)\right]$

$$= \max_p \delta\left\{\int_{-\infty}^{\hat{\beta}\delta b - p} (\delta b - p - c) dF(c) - \bar{u} - K + \int_{-\infty}^{\beta\delta b - p} (p - a)\, dF(c)\right\}$$

$$= \max_p \delta\left\{\int_{-\infty}^{\beta\delta b - p} (\delta b - a - c) dF(c) - \bar{u} - K + \int_{\beta\delta b - p}^{\hat{\beta}\delta b - p} (\delta b - p - c)\, dF(c)\right\}$$

The Firm's Problem

Claim:

- Optimal price equal to marginal cost when $\beta = \hat{\beta} = 1$
- Optimal price less than marginal cost when $\beta \leq \hat{\beta} < 1$

To see this, solve for optimal price, p^*

$$\frac{\partial \pi(p)}{\partial p} = f(\beta\delta b - p)\left[(a-p) - \underbrace{\left(1-\hat{\beta}\right)\delta b \frac{f(\hat{\beta}\delta b - p)}{f(\beta\delta b - p)}}_{\text{WTP for commitment}} - \underbrace{\frac{F(\hat{\beta}\delta b - p) - F(\beta\delta b - p)}{f(\beta\delta b - p)}}_{\text{overconfidence}}\right]$$

The Firm's Problem

- With monopoly pricing, argument extends to leisure goods
  - Consumers want above marginal cost pricing because to discourage consumption, but they consume more than they plan to
  - Possible examples: credit cards, mini bars, mobile phones
- Extends to case of competition?
  - How might investment, leisure goods differ under competition?