14.13 Economics and Psychology
(Lecture 6)

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February 24, 2004

1 Midterm and Problem Sets

- Problem Set 1: average score $\mu = 35/50$, standard deviation $\sigma = 9.9$.

- Grades will be increased by 10%.

- Problem Set 2: given Thursday 2/26, due Thursday 3/4

- Problem Set 3: given Thursday 3/11, due *Tuesday* 3/16.

- Midterm: Thursday 3/18

2 Two extensions of PT

- Both outcomes, x and y, are positive, $0 < y < x$. Then,

$$V = v(y) + \pi(p)(v(x) - v(y)).$$

Why not $V = \pi(p) v(x) + \pi(1 - p) v(y)$? Because it becomes self-contradictory when $x = y$ and we stick to K-T calibration that puts $\pi(.5) < .5$.

- Same formula for negative gambles, $0 > y > x$.

- Continuous gambles, distribution $f(x)$
  EU gives:

$$V = \int_{-\infty}^{+\infty} u(x) f(x) dx$$

  PT gives:

$$V = \int_{0}^{+\infty} u(x) f(x) \pi' (P(g \geq x)) dx + \int_{-\infty}^{0} u(x) f(x) \pi' (P(g \leq x)) dx$$

3 The endowment effect – a consequence of PT

- Lab experiment, Kahneman, Knetsch, Thaler, JPE 1990.
  - Half of the subjects receives an MIT apple, and the other half receives \$10.
  - Then willingness to pay WTP for the apple is elicited from subjects with money, and willingness to accept WTA is elicited from subjects with apples.
- In EU we have $WTP = WTA$ (modulo wealth effects, which are small)

- In simplified (linear) PT value getting an apple and lose/paying $\$x$ is

$$V = u\,(\text{apple}) + u\,(-x) = A - \lambda x$$

(note—there are mental accounting ideas plugged in here that is we process apple and money on separate accounts).

- Thus, in PT, one pays when

$$A - \lambda x \geq 0$$

so that

$$WTP = \frac{A}{\lambda}.$$

- In simplified (linear) PT value losing an apple and gaining $\$x$ is

$$V = u\left(-\text{apple}\right) + u\left(x\right) = -\lambda A + x$$

(note, once more time we process apple and money on separate accounts).

- Thus, in PT, one accepts when

$$-\lambda A + x \geq 0$$

so that

$$WTA = \lambda A.$$

- Thus, PT gives stability to human life, a status quo bias.

3.1 Endowment effect experiment with mugs

- Classroom of one hundred. Fifty get the mug, fifty get \$20. Then, one does a call auction in which people can trade mugs.

- Trading volume — "rational" expectation for EU agents ($\lambda = 1$ and $WTP = WTA$) would be that the average trading volume should be

$$\frac{1}{2}50 = 25.$$

  Everybody has a valuation, and probability that someone with valuation higher than the market price is $\frac{1}{2}$.

- If $WTP < WTA$ then the trading volume is lower than $\frac{1}{2}$.

- In experiments, the trading volume is about $\frac{1}{4}$.

3.2 Open questions with PT

3.2.1 Open question 1: Narrow framing

- N independent gambles: $g_1, ..., g_N$

- For each i do you accept g_i or not?

- In EU call $a_i = 1$ if accept g_i and $a_i = 0$ otherwise. Your total wealth is

$$W_0 + a_1 g_1 + ... + a_N g_N$$

and you maximize

$$\max_{a_1,...,a_N} Eu\left(W_0 + a_1 g_1 + ... + a_N g_N\right).$$

- In PT we have at least two possibilities
  - Separation: $a_i = 1$ iff $V^{PT}(g_i) > 0$.
  - Integrative: solve $\max_{a_1,...,a_N} V^{PT}(a_1 g_1 + ... + a_N g_N)$.
- Separation is more popular, but unlikely for example in stock market, or venture capital work.
- KT don't tell whether integration or separation will be chosen. That is one of the reasons PT has not been used much in micro or macro.

- How to fix this problem?
  - Integration as far as possible subject to computational costs.
  - Natural horizon between now and when I need to retire.
  - Do what makes me happier, $\max(\text{separation,integration})$. That would be an appealing general way to solve the problem.
    * Problem, each everyday gamble is small against the background of all other gambles of life.
    * So, an EU maximizer would be locally risk neutral.
    * And also a PT maximizer would be locally risk neutral whenever he or she accpets integrationist frame.

3.2.2 Horizon problem — a particular case of the framing problem

- Stock market.
  - Yearly values

$$\text{standard deviation } \sigma T^{\frac{1}{2}} = 20\% \text{ per year where } T \simeq 250\text{days},$$

$$\text{mean } \mu T = 6\% \text{ per year.}$$

  - Daily values

$$\sigma = \frac{20\%}{250^{\frac{1}{2}}} = .024$$
$$\mu = \frac{6\%}{T} = 1.3$$

– Assume that a PT agent follows the rule: "accept if $\frac{\text{Risk premium}}{\text{St. dev.}} > k$" (PS1 asks to show existence of such an PT agent).

– So, a PT agent with yearly horizon invests if

$$\frac{6\%}{20\%} > k^*$$

– A PT agent with daily horizon invests if

$$\frac{\mu}{\sigma} = \frac{.024}{1.3} \simeq .01 << k^*$$

- This is not even a debated issue, because people don't even know how to start that discussion.

- Kahneman says in his Nobel lecture that people use "accessible" horizons.

  * E.g. in stock market 1 year is very accessible, because mutual funds and others use it in their prospectuses.

  * Other alternatives – time to retirement or time to a big purchase. or "TV every day".

- In practice, for example Barberis, Huang, and Santos QJE 2001 postulate an exogenous horizon.

3.2.3 Open question 2: Risk seeking

- Take stock market with return $R = \mu + \sigma n$ with $n \sim N(0, 1)$.

- Invest proportion θ in stock and $1 - \theta$ in a riskless bond with return 0.

- Total return is

$$\theta R + (1 - \theta) 0 = \theta (\mu + \sigma n).$$

- Let's use PT with $\pi(p) = p$. The PT value is

$$V = \int_{-\infty}^{+\infty} u(\theta(\mu + \sigma n)) f(n)\, dn$$

- Set $u(x) = x^{\alpha}$ for positive x and $-\lambda |x|^{\alpha}$ for negative x.

- Using homothecity of u we get

$$\begin{aligned} V &= \int_{-\infty}^{+\infty} |\theta|^{\alpha} u(\mu + \sigma n) f(n)\, dn \\ &= |\theta|^{\alpha} \int_{-\infty}^{+\infty} u(\mu + \sigma n) f(n)\, dn \end{aligned}$$

- Thus optimal θ to equals 0 or $+\infty$ depending on sign of the last integral.

- Why this problem? It comes because we don't have concave objective function. Without concavity it is easy to have those bang-bang solutions.

- One solution to this problem is that people maximize $V^{EU} + V^{PT}$.

3.2.4 Open question 3: Reference point

- Implicitly we take the reference point R_t to be wealth at $t = 0$. Gamble is $W_0 + g$ and

$$V^{PT} = V^{PT}(W_0 + g - R_t)$$

- But how R_t evolves in time?

- In practice, Barberis, Huang, and Santos QJE 2001 (the most courageous paper) postulate some ad hoc exogenous process. People gave them the benefit of a doubt.

3.2.5 Open question 4: Dynamic inconsistency

- Take a stock over a year horizon. Invest 70% on Jan 1st, 2001.

- It's Dec 1, 2001. Should I stay invested?

- If the new horizon is now one month, I may prefer to disinvest, even though on Jan 1, 2001, I wanted to keep for the entire year.

- By backward induction, Jan 1 guy should disinvest!

3.2.6 Open question 5: Doing welfare is hard

- Why? Because it depends on the frame.

- Take $T = 250$ days of stock returns $g_i = \mu + \sigma n_i \sim N\left(\mu, \sigma^2\right)$ with iid n_i. Integrated $V^I = V^{PT}\left(\sum g_i\right)$ and separated $V^S = \sum V^{PT}\left(g_i\right)$.

- The cost of the business cycle (Lucas). Suppose $c =$average monthly consumption. Assume simple consumption shocks:

$$c_t = c + \varepsilon_t$$

with normal iid ε_t with $E\varepsilon_t = 0$. Empirically, the standard deviation of consumption over the business cycle is 2%.

- What is PT reference point? Take $R_t = c = 0$.

- With PT integrated over one year

$$V^I = V^{PT}\left(\sum \varepsilon_t\right) = V^{PT}\left(12^{\frac{1}{2}}\sigma_\varepsilon n_1\right) = \left(12^{\frac{1}{2}}\sigma_\varepsilon\right)^\alpha V^{PT}(n_1) < 0.$$

- With segregated PT

$$V^S = 12\sigma_\varepsilon^\alpha V^{PT}(n)$$

- Which frame is better?

Lucas calculation in EU

- In EU the welfare is well defined

$$V = Eu\left(c + \varepsilon_t\right)$$

where c and ε_t are components of consumption described above.

- Lucas measured the welfare loss associated with business cycle $\varepsilon_t$by the fraction λ of consumption that people would accept to give up in order to avoid consumption variability.

- λ solves

$$V = Eu\left(c + \varepsilon_t\right) = u\left(\left(1 - \lambda\right)c\right)$$

- Problem Set 2 asks you to take

$$u(c_t) = \frac{c^{1-\gamma}}{1-\gamma}$$

for a positive $\gamma \neq 1$, and to show that

$$\lambda = \frac{\gamma}{2}\sigma^2 = \gamma\frac{4}{2}10^{-4} = 2\gamma \cdot 10^{-4}$$

- If $\gamma \simeq 1$ and $\sigma =$standard deviation of $\varepsilon \simeq 2\%$, then $\lambda \simeq 0.02\%$ for EU consumers. Thus business cycle is irrelevant from this perspective.

- As we showed above PT consumers may value stability more as they are first order risk averse around their reference point. But their risk aversion strongly depends on horizon. Should it be yearly, monthly, daily?

4 Reading for next lecture

Tversky, A. and Kahneman, D. "Judgement under uncertainty: Heuristics and biases", Science, 185, 1974, p.1124-31.