14.127 Behavioral Economics (Lecture 2)

Xavier Gabaix

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0.1 Cumulative PT

- Remind from last lecture: for continuous gambles with distribution $f(x)$
  EU gives:
  $$V = \int_{-\infty}^{+\infty} u(x) f(x) \, dx,$$
  PT gives:
  $$\begin{aligned} V = & \int_{0}^{+\infty} u(x) f(x) \pi' (P(g \geq x)) \, dx \\ & + \int_{-\infty}^{0} u(x) f(x) \pi' (P(g \leq x)) \, dx \end{aligned}$$

- Alternatively, we can write it as Riemann-Stieltjes integral

$$V = -\int_{0}^{+\infty} u(x)\, d\pi\left(1 - P(g < x)\right) + \int_{-\infty}^{0} u(x)\, d\pi\left(P(g \leq x)\right)$$

- This simplifies to PT for two outcome gambles. Indeed, it is self-evident in the Riemann-Stieltjes form.

1 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 mugs.
- In EU we have $WTP = WTA$ (modulo wealth effects, which are small)

- In simplified (linear) PT value getting an apple and lose $\$x$ 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 accepts when

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

so that

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

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

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

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

- Thus, in PT, one pays when

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

so that

$$WTP = \lambda A.$$

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

1.1 Endowment effect experiment with mugs

- Classroom of one hundred. Fifty get the mug, fifty get \$20.

- One does a call auction in which people can trade mugs.

- Trading volume — "rational" expectation 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 $\frac{1}{4}$.

1.2 Open questions with PT

1.2.1 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 $V^{PT}(g_i)$.
  - Integrative: solve $\max_{a_1,...,a_N} V^{PT}(a_1 g_1 + ... + a_N g_N)$.
- Separation is more popular, but unlikely in 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.

1.2.2 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

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

– 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.

1.2.3 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

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

- 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 $V^{EU} + V^{PT}$.

1.2.4 Open question 3: Reference point

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

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

- 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.

1.2.5 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!

1.2.6 Open question 5: Doing welfare is hard

- Why? Because it depends on the frame.

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

- 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.

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

- With PT integrated over one year

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

- With segregated PT

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

- Which frame is better?

1.3 Next time

- Lucas calculation of costs of business cycle. In practice people care about business cycles, and election are decided on those counts.

- Problem Set — next time. One question – try to circumvent one of the problems.

- Readings on heuristics and biases, the Science 74 KT article and Camerer's paper from the syllabus.