Stochastic Choice (Part 1)

October 25, 2021

Samuelson (1963)

a few years ago I offered some lunch colleagues to bet each $200 to $100 that the side of a coin they specified would not appear at the first toss. One distinguished scholar - who lays no claim to advanced mathematical skills - gave me the following answer:

"I won't bet because I would feel the $100 loss more than the $200 gain. But I'll take you on if you promise to let me make 100 such bets."

Standard "behavioral" explanation

- Keep things simple and consider two instead of 100 lotteries

  Assume:

  $$u(x) = \begin{cases} x & \text{if } x \geq 0 \\ \lambda x & \text{if } x < 0 \end{cases}$$

- Can find $\lambda \in (1, \infty)$ such that one lottery is rejected but two lotteries are accepted

- **Explanation:** People are loss averse and loss aversion has less of an impact when decisions are **broadly framed**

Gneezy and Potters (1997)

- Basic task: subject given 200 cents, decides how much to invest in a risky lottery
  - Probability 2/3 of losing the bet
  - Probability 1/3 of winning 2.5 times the amount bet
- You keep whatever out of 200 you do not invest

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  - Probability 2/3 of losing the bet
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- You keep whatever out of 200 you do not invest
- **Narrow treatment:** You make the investment decision one at a time, 9 times in a row
- **Broad treatment:** You make three investment decisions at a time, 3 times in a row
- **Predictions:** More willingness to take risks in the broad treatment

Results

TABLE I

AVERAGE PERCENTAGE OF ENDOWMENT BET (PART 1)

	Treatment H[a]	Treatment L[a]	Mann-Whitney z[b]
Rounds 1–3	52.0 (30.2)	66.7 (29.5)	−2.08 [0.018]
Rounds 4–6	44.8 (30.0)	63.7 (30.3)	−2.78 [0.003]
Rounds 7–9	54.7 (28.9)	71.9 (29.4)	−2.51 [0.006]
Rounds 1–9	50.5 (26.7)	67.4 (27.3)	−2.86 [0.002]

a. # obs. = 41 (42) for treatment H (L). Standard deviations are in parentheses.
b. One-tailed significance levels (p-values) are in brackets.

Interpretation: Victory of the loss aversion model! People take more risks when decisions are broadly framed because loss aversion has less of an impact.

Thaler, et al. (1997)

- Basic task: subject decides between drawing reward from two distributions
  - $\mu_H = 1$, $\sigma_H = 3.54$
  - $\mu_L = 0.25$, $\sigma_L = 0.177$

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- Basic task: subject decides between drawing reward from two distributions
  - $\mu_H = 1$, $\sigma_H = 3.54$
  - $\mu_L = 0.25$, $\sigma_L = 0.177$
- **Narrow treatment:** 200 decisions, one per period
- **Yearly treatment:** 25 decisions, each binding for 8 periods
- **Five-yearly treatment:** 5 decisions, each binding for 40 periods
- **Predictions:** More willingness to take risks in the yearly and five-yearly treatments

Results

TABLE I
ALLOCATIONS TO BOND FUND

	Percent allocation to bond fund			
Feedback group	*n*	Mean	*SD*	*SE*
		A. Final decision		
Monthly	21	59.1	35.4	7.73
Yearly	22	30.4[b]	25.9	5.51
Five-yearly	22	33.8[b]	28.5	6.07
Inflated monthly	21	27.6[b]	23.2	5.07
		B. During the last five years		
Monthly	840	55.0	31.8	1.10
Yearly	110	30.7[a]	27.0	2.57
Five-yearly	22	28.6[a]	25.1	5.36
Inflated monthly	840	39.9	33.5	1.16

In each column, means with common superscripts do not differ significantly from one another ($p > .01$).

Observation

- The risky option is attractive to a risk-neutral decision maker in both treatments of Samuelson's choice experiment
- ...and in both treatments of Gneezy and Potters (1997)
- ...and in both treatments of Thaler, et al. (1997)
- ...and in both treatments of other studies of myopic loss aversion
- **Randomness in choice makes same prediction as risk aversion**

Random choice

- Consider Thaler, et al (1997)
- Assume $U_H = \mu_H + \epsilon_H$, $U_L = \mu_L + \epsilon_L$ (risk neutrality with random error)
- ϵ_H and ϵ_L are i.i.d. errors from Gumbel distribution
- Narrow treatment: $P_H = \frac{1}{1+\exp(\mu_L - \mu_H)}$
- Broad treatment: $P_{3H} = \frac{1}{1+\exp(3(\mu_L - \mu_H))} > P_H$

New experiment: Evdokimov (2021)

- Basic task: Choice between a fixed lottery (0 with 50%, 60 pesos with 50%) and a certain amount $c \in \{20, 30, 40\}$
  - c low $\Rightarrow$ lottery attractive (as in Samuelson and Gneezy and Potters)
  - c high $\Rightarrow$ lottery unattractive

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- **Narrow framing:** One lottery vs. one sure amount c

- **Broad treatment:** Three lotteries (coin flipped three times) vs. $3 \times c$

Predictions

- No losses in the experiment, so loss aversion per se makes no prediction. According to KT, loss aversion reduces to risk aversion in the gain domain
- **Risk averse prediction:** DM takes more risks in the broad treatment for all values of c
- **Random preferences prediction:** DM takes more risks in the broad treatment when c is low and more risks in the narrow treatment when c is high ($P_L = \frac{1}{1+\exp(c-30)}$, $P_{3L} = \frac{1}{1+\exp(3(c-30))}$)

Results

Result 1 (**Crossover pattern**). *Consistent with random preferences, subjects are* ***more*** *willing to take risks in T3 than in T1 when* $s = 20$ *and* ***less*** *willing to take risks in T3 than in T1 when* $s = 40$.

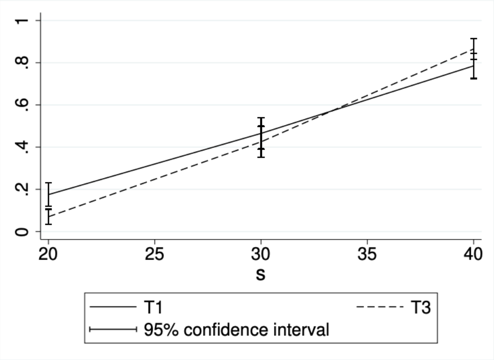

Figure 1: **The probability of making the safe choice in treatments T1 and T3.** The variable s represents the safe amount in each decision in T1 and the safe amount divided by three in T3. When $s = 20$, subjects were more risk-averse in T1, but when $s = 40$ the result was reversed.

Conclusion

- Random preferences is a better theory of the effect of aggregating lottery choices than loss aversion
- Intuition: aggregation of choices raises the stakes and makes it less likely you make a mistake