Risk Preferences

PROSPECT THEORY III: LOSS AVERSION

EE416 SEM2/2019

Recap

In mixed gambles $\mathrm{L} = (x, p; y, q), x > 0, y < 0$, where both a gain and a loss are possible, loss aversion causes extremely risk-averse choices.

In a situation where a sure loss is compared to a gamble with (highly) probable larger loss, diminishing sensitivity cause risk seeking.

In a situation where a sure gain is compared to a gamble with (highly) probable larger gain, diminishing sensitivity cause risk aversion.

Recap: The Endowment Effect

- Endowment Effect (coined by Thaler, JEBO 1980)

People tend to value an object more highly when they own it than when they do not.

- Kahneman, Knetsch, & Thaler (JPE 1990)

First (relatively) clean experimental demonstration of the endowment effect.

Endowment Effect: Mug Experiment
Design

	
Potential "Sellers"	Potential Buyers

Each seller were given a coffee mug.

Each buyer were shown a coffee mug.

Endowment Effect: Mug Experiment
Result

- a “Chooser” group: elicit the amount of money at which they would be indifferent between receiving a mug and receiving the money

  Choices:

  Sellers: (mug, $0) vs. (no mug, $5)

  Buyers: (mug, -$5) vs. (no mug, $0)

  Choosers: (mug, $0) vs. (no mug, $5)

- Sellers and choosers have the exact same choice!

Endowment Effect: Mug Experiment Design

Elicit people's reservation values (or reservation prices):

A buyer's WTP is the maximum amount she is willing to pay to obtain the object.

A seller's WTA is the minimum amount she is willing to accept to part with the object.

If there is a WTP > WTA in the group, they trade.

Sellers [Buyers]	I will sell [I will buy]	I will keep mug [I will not buy]
If the price is $0.00:		
If the price is $0.50:		
...		
If the price is $9.00:		
If the price is $9.50:		

Choosers: **indicate for each price whether they want the mug or the money.**

Endowment Effect: Mug Experiment
Result

Results:

Sellers: $7.12

Buyers: $2.87

Choosers: $3.12

A more general overall utility function:

$$U(x|r) \equiv u(x) + v(x|r)$$

- x is final consumption, r is the reference point
- $u(x)$ is intrinsic utility from consumption ("standard economic utility")
- $v(x|r)$ is gain-loss utility

A Simple Model of Loss Aversion & the Endowment Effect

Assume preferences described by

$$U(c, m|r) \equiv u(c|r) \quad + \quad m$$

Assume $r \in \{0, 1\}$

- $r = 0 \iff$ unendowed (buyers and choosers)
- $r = 1 \iff$ endowed (sellers)

Assume $c \in \{0, 1\}$

- $c = 1 \iff$ go home with mug (buy, choose, or keep).
- $c = 0 \iff$ go home without mug (don't buy, don't choose, or sell)

A Simple Model of Loss Aversion & the Endowment Effect

Assume $u(c|r) =$

	$r = 0$	$r = 1$
$c = 0$	0	$-\lambda\phi$
$c = 1$	$\mu + \phi$	μ

Note: Loss aversion means $\lambda > 1$.

Loss aversion and endowment effect

Given wealth w and price p:

Sellers sell if:

$-\lambda\phi + w + p > \mu + w$, where $-\lambda\phi$ is mug utility, and $w + p$ is money utility

$$p > \mu + \lambda\phi \equiv \bar{p}_s$$

Buyers buy if:

$\mu + \phi + w - p > 0 + w$

$$p < \mu + \phi \equiv \bar{p}_B$$

Coefficient of Loss Aversion
Measurement

- Earlier, we measured the coefficient of loss aversion from answers to whether you would accept a bet with a 50% chance to win X , and a 50% chance to lose Y , where:

Coefficient of Loss Aversion $= \frac{X}{Y}$ for the smallest X given a fixed Y, OR for the largest Y given a fixed X

- We can also measure the coefficient of loss aversion using the endowment effect experiment:

Coefficient of Loss Aversion $= \frac{WTA}{WTP}$

Rabin's calibration(Rabin, Econometrica 2000)

People tend to dislike risky prospects even when they involve an expected gain.

E.g. A 50-50 gamble of losing $100 vs. gaining $105.

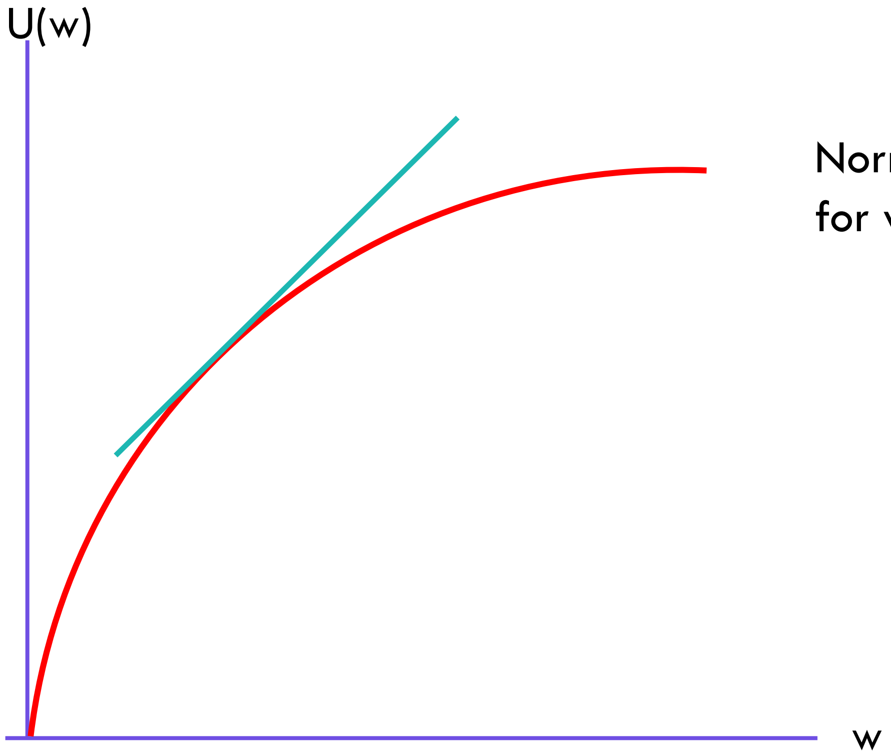
Economists'explanation:

EU theory with a concave utility function.

Rabin's Point:

This explanation doesn't work, because according to EU theory, anything but virtual risk neutrality over modest stakes implies manifestly unrealistic risk aversion over large stakes.

Rabin's calibration(Rabin, Econometrica 2000)



Normal concave utility function is risk-neutral for very small stake gambles.

We can use 'loss aversion' to explain risk averse behavior in small stake gamble.

A New Approach to Loss Aversion (Koszegi & Rabin,2006)

Goal is to develop a more generally applicable theory of **reference-dependent utility with loss aversion.** They address two major issues:

1) When do people experience loss aversion, and what is the magnitude of this experience?

2) What determines the reference point?

A New Approach to Loss Aversion
(Koszegi & Rabin,2006)

They address these issues by introducing three key innovations:

- They develop a new reference-dependent utility function that directly ties gain-loss utility to intrinsic utility.
- They develop a new model of a stochastic referent.
- They develop new models in which a person's referent is her recent beliefs or expectations about outcomes.

A new reference-dependent utility function

Notation:

- Let $\mathbf{x} \equiv (x^1, ..., x^K)$ denote a consumption bundl
- Let $\mathbf{r} \equiv (r^1, ..., r^K)$ denote a reference point.
- Let $U(\mathbf{x}|\mathbf{r})$ denote utility as a function of $\mathbf{x}$ and $\mathbf{r}$

Assumptions about $U(\mathbf{x}|\mathbf{r})$:

$$U(\mathbf{x}|\mathbf{r}) \equiv u(\mathbf{x}) + v(\mathbf{x}|\mathbf{r})$$

- $u(\mathbf{x})$ is "intrinsic utility".
- $v(\mathbf{x}|\mathbf{r})$ is "gain-loss utility".

A new reference-dependent utility function

Assume additive separability across consumption dimensions:

$$u(\mathbf{x}) \equiv \sum_{k=1}^{K} u_k(x^k)$$

$$\text{and} \quad v(\mathbf{x}|\mathbf{r}) \equiv \sum_{k=1}^{K} v_k(x^k|r^k).$$

Gain-loss utility is tied directly to intrinsic utility:

$$\text{For each } k: \quad v_k(x^k|r^k) \equiv \mu(u_k(x^k) - u_k(r^k))$$

where $\mu(z)$ is a "universal gain-loss function".

A new reference-dependent utility function

Gain-loss utility is tied directly to intrinsic utility:

$$\text{For each } k: \quad v_k(x^k | r^k) \equiv \mu(u_k(x^k) - u_k(r^k))$$

where $\mu(z)$ is a "universal gain-loss function".

$\mu(z)$ is such as:

$$\mu(z) = \begin{cases} \eta z & \text{if } z \geq 0 \\ \lambda \eta z & \text{if } z \leq 0 \end{cases}$$

A new reference-dependent utility function: Lottery L

Suppose that instead of facing a certain consumption bundle $\mathbf{x}$, you face a lottery L over consumption bundles. Then your utility is

$$U(L|\mathbf{r}) = \int_{\mathbf{x}} [u(\mathbf{x}) + v(\mathbf{x}|\mathbf{r})] \, dL(\mathbf{x}).$$

Example: If $L = (200, \frac{1}{4}; 0, \frac{3}{4})$ and $r = 100$, then

$$U(L|r) = \frac{1}{4}[u(200) + v(200|100)] + \frac{3}{4}[u(0) + v(0|100)].$$

A new reference-dependent utility function: Stochastic referent R

Suppose instead that you have a certain consumption bundle $\mathbf{x}$, but your referent is a lottery R over reference points $\mathbf{r}$. Then your utility is

$$U(\mathbf{x}|R) = \int_{\mathbf{r}} [u(\mathbf{x}) + v(\mathbf{x}|\mathbf{r})] \, dR(\mathbf{r}).$$

Example: If $x = 100$ and $R = (150, \frac{1}{3}; 50, \frac{2}{3})$, then

$$U(x|R) = \frac{1}{3}[u(100) + v(100|150)] + \frac{2}{3}[u(100) + v(100|50)].$$

A new reference-dependent utility function: Lottery L and stochastic referent R

Finally, if you face a lottery L over consumption bundles, and your referent is a lottery R, then your utility is

$$U(L|R) = \int_{\mathbf{x}} \int_{\mathbf{r}} [u(\mathbf{x}) + v(\mathbf{x}|\mathbf{r})] \, dL(\mathbf{x}) dR(\mathbf{r}).$$

Example: If $L = (200, \frac{1}{4}; 0, \frac{3}{4})$ and $R = (150, \frac{1}{3}; 50, \frac{2}{3})$, then

$$\begin{aligned} U(L|R) &= \frac{1}{4}\left[\frac{1}{3}[u(200) + v(200|150)] + \frac{2}{3}[u(200) + v(200|50)]\right] \\ &+\frac{3}{4}\left[\frac{1}{3}[u(0) + v(0|150)] + \frac{2}{3}[u(0) + v(0|50)]\right] \end{aligned}$$

The referent is recent expectations.

Koszegi & Rabin posit that a person's referent is her recent beliefs or expectations about outcomes.

Empirical Applications of Loss Aversion:

Odean (Journal of Finance 1998)

- Identifies a reference-point effect:

Domain: equity markets.

Reference point: nominal purchase price of stocks.

- Disposition Effect: When investors sell their stocks, they are more prone to sell their winners than their losers.

Note: A stock is a winner if its current price is above its purchase price, and it is a loser if its current price is below its purchase price.

Empirical Applications of Loss Aversion:
Camerer, Babcock, Loewenstein, & Thaler (QJE 1997)

- Identify an empirical anomaly, accommodate with loss aversion.

For many jobs, people choose how to allocate their labor from day-to-day, or from week-to-week, or from month-to-month.

- Benchmark: The standard life-cycle model of labor supply says that, if your wage varies over time, you should work more when the wage is high than you do when the wage is low. You efficiently allocate your work effort.

They test this prediction on NYC cab drivers.

Empirical Applications of Loss Aversion:

Camerer, Babcock, Loewenstein, & Thaler (QJE 1997)

- Data: Three samples of trip sheets.

TRIP: 70 trip sheets from 13 drivers (spring 1994 from one fleet company).

TLC1: 1044 trip sheets from 484 drivers (fall 1990 from TLC).

TLC2: 712 trip sheets from 712 drivers (fall 1988 from TLC).

Empirical Applications of Loss Aversion:

Camerer, Babcock, Loewenstein, & Thaler (QJE 1997)

- They take their unit of observation to be a day, in particular, they estimate a daily wage equation:
- $lnH_t = \gamma lnW_t + \beta X_t + \epsilon_t$
- H_t is hours worked on day t.
- W_t is average wage on day t.
- Standard model predicts $\gamma > 0$, that is, positive wage elasticity.

TABLE II
OLS Log Hours Worked Equations

Sample	TRIP		TLC1		TLC2
Log hourly wage	−.411	−.186	−.501	−.618	−.355
	(.169)	(.129)	(.063)	(.051)	(.051)
High temperature	.000	−.000	.001	.002	−.021
	(.002)	(.002)	(.002)	(.002)	(.007)
Shift during week	−.057	−.047	−.004	.030	—
	(.019)	(.033)	(.035)	(.042)	
Rain	.002	.015	—	—	−.150
	(.035)	(.035)			(.062)
Night shift dummy	.048	−.049	−.127	−.294	−.253
	(.053)	(.049)	(.034)	(.047)	(.038)
Day shift dummy	—	—	.000	.053	—
			(.028)	(.045)	
Fixed effects	No	Yes	No	Yes	No
Adjusted R^2	.243	.484	.175	.318	.146
Sample size	70	65	1044	794	712
Number of drivers	13	8	484	234	712

Dependent variable is the log of hours worked. Standard errors are in parentheses and are corrected for the nonfixed effects estimates in coulmns 1 and 3 to account for the panel structure of the data. Explanatory variables are described in Appendix 1.

Empirical Applications of Loss Aversion:

Camerer, Babcock, Loewenstein, & Thaler (QJE 1997)

- Main result: They estimate $\gamma < 0$. that is, negative wage elasticity.
- Hence, they have identified an anomaly: The standard model predicts positive wage elasticities, but they found negative wage elasticities.
- Accommodate with loss aversion, specifically, their explanation is income targeting driven by loss aversion:
  - one-day time horizon for decision making.
  - reference point is a daily income target.
  - losses relative to the target loom larger than gains.

A Simple Model of Income Targeting

O'donoghue(lecture note, 2019)

Suppose a person is choosing how many hours h to work today when today's wage is w.

A "standard" model:

- Assume utility is additive separable in earnings and hours (effort).
- For daily decisions, natural to assume utility is linear in earnings and convex in hours.
- Hence, assume person chooses H to maximize

$$U(H) = wH - c(H).$$

A model of income targeting:

- Suppose a person has an income target $\bar{Y}$, and loss aversion around this target using two-part linear value function $v(z)$.
- Hence, assume person chooses H to maximize

$$U(H) = wH - c(H) + v(wH - \bar{Y}).$$

Enhancing the Efficacy of Teacher Incentives Through Loss Aversion: A Field Experiment (Fryer, Levitt, List & Sadoff)

The paper demonstrated that exploiting the power of loss aversion—teachers are paid in advance and asked to give back the money if their students do not improve sufficiently—increases math test scores.

- The “Gain” treatment – received “traditional” financial incentives in the form of bonuses at the end of the year linked to student achievement.
- The “Loss” treatment – were given a lump sum payment at the beginning of the school year and informed that they would have to return some or all of it if their students did not meet performance targets.
- Importantly, teachers in the “Gain” and “Loss” groups with the same performance received the same final bonus.

Blindspots of Prospect theory

- Consider following prospects
  - A. 1 in 1,000,000 to win $1,000,000
  - B. 90% chance to win $12 and 10% chance to win nothing
  - C. 90% chance to win $1 million and 10% chance to win nothing
- Consider following problems
  - Choose between 90% chance to win$1 million or $50 with certainty
  - Choose between 90% chance to win$1 million or $150,000 with certainty

Blindspots of Prospect theory

- Prospect theory doesn't address how the reference point is formed.
- Prospect theory doesn't allow the value of an outcome to change when it is highly unlikely, or when the alternative is very valuable.
- Prospect theory cannot deal with disappointment.
- Prospect theory assumes that available options in a choice are evaluated separately and independently, and the choice with the highest value is selected.
- Prospect theory doesn't allow for regret.