Reference Dependence Lecture 1

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Plan for this Part of Course

- Bounded Rationality (4 lectures)
- Reference dependence (3 lectures)
- Neuroeconomics (2 lectures)
- Temptation and Self control (3 lectures)

Tentative Plan For Reference Dependence

- Introduction to reference dependence
- Prospect theory: the Standard Model
- Alternative models of reference dependence
    - Koszegi and Rabin
    - Masatlioglu and Ok
- Applications
    - Labor Supply
    - Contracting
    - Pricing

Tentative Plan For Reference Dependence

- What do we mean by reference dependent preferences?
- Examples of reference dependent behavior
- Prospect theory

Canoncial Description of Reference Dependence

- Standard model of choice

$$C : \mathcal{X} \rightarrow X,$$

  $C(A)$ is the choice from set A

- Reference dependent model of choice

$$C : \mathcal{X} \times X \rightarrow X,$$

  $C(A, x)$ is the choice from set A when reference point is x

- Changing the reference point can change choices despite choice set not changing

What is a Reference Point?

- Good question
    - What you currently have? (status quo bias)
    - What you get if you do nothing? (omission bias/inertia)
    - What you expect to get? (personal equilibrium)
    - What other people have? (other regarding preferences - not in this section)
- Many models treat status quo as given
- Others (e.g. Koszegi and Rabin) attempt to jointly model choice and determination of reference point

What Causes Reference Dependence?

- It is possible (likely?) that there are many different causes of reference dependence
- Some of these might best be thought of as 'boundedly rational'
    - Transaction costs
    - Thinking cost
    - Optimal Information Processing [e.g. Woodford 2012]
- Others might be best thought of as preference based
    - Habit formation
    - Dislike of losses from ones current position
- In this section we will concentrate on models that have (at least no explicit) boundedly rational justification

Types of Reference Dependent Behavior

- Reflection Effect
- Higher risk aversion for mixed gambles
- Endowment Effect
- Status Quo Bias

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Reflection Effect [KT 1986]

- Two groups of subjects
  - Each group offered a different choice
- Set up for each choice the same:

"An outbreak of a disease is expected to cause 600 deaths in the US. Two mutually exclusive programs are expected to yield the following results"

Reflection Effect [KT 1986]

- Choice A
  - 400 people will die
  - With probability 1/3, 0 people will die, while with probability 2/3 600 people will die
- Choice B
  - 200 people will be saved
  - With probability 1/3, all 600 people will be saved, while with probability 2/3 none will be saved
- In choice A, 78% chose 2
- In choice B, 28% chose 2
- Interpretation: people are more risk averse in the gain domain than in the loss domain

Reflection Effect [KT 1979]

- Choice 1

	Option A	Option B
Desc	50% 1000, 50% 0	100% 500
Prop	16	84

- Choice 2

	Option A	Option B
Desc	50% -1000, 50% 0	100% -500
Prop	69	31

- Note that this *could* be explained if people happen to be at a kink in their indifference curve
- But would be a knife-edge case (and doesn't explain previous example)

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Thaler et al. [1997]

- Subjects asked to make portfolio allocation decision for 200 periods
  - Risky stocks
  - Safe Bonds
- Two treatments (of interest to us)
- Monthly
  - Stocks have returns distributed N(1,3.54)
  - Bonds have returns distributed N(0.25,1.77) truncated at 0
- Monthly inflated
  - Returns inflated so stocks never have negative return

Thaler et al. [1997]

TABLE I
ALLOCATIONS TO BOND FUND

Feedback group	n	Mean	SD	SE
	Percent allocation to bond fund			
		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 ($p > .01$).

- Higher appetite for stocks in the 'Monthly Inflated' treatment

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Kahnemann, Knetch and Thaler [1990]

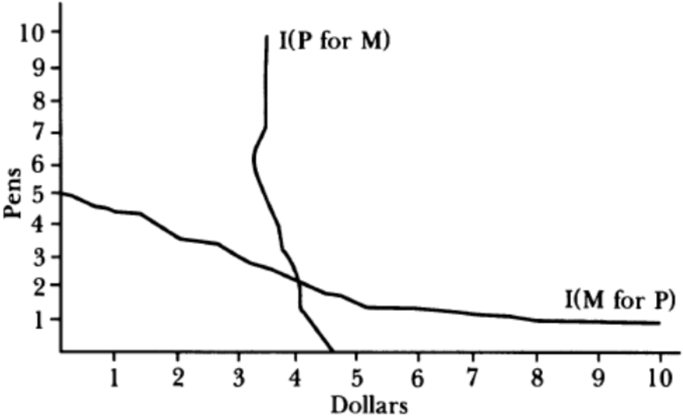
- 44 subjects
- 22 Subjects given mugs
- The other 22 subjects given nothing
- Subjects who owned mugs asked to announce the price at which they would be prepared to sell mug
- Subjects who did not own mug announced price at which they are prepared to buy mug
- Experimenter figured out ‘market price’ at which supply of mugs equals demand
- Trade occurred at that market price

Kahnemann, Knetch and Thaler [1990]

- Prediction: As mugs are distributed randomly, we should expect half the mugs (11) to get traded
  - Consider the group of 'mug lovers' (i.e. those that have valuation above the median), of which there are 22
  - Half of these should have mugs, and half should not
  - The 11 mug haters that have mugs should trade with the 11 mug lovers that do not
- In 4 sessions, the number of trades was 4,1,2 and 2
- Median seller valued mug at $5.25
- Median buyer valued mug at $2.75
- Willingness to pay/willingness to accept gap

Kahnemann, Knetch and Thaler [1990]

Figure 1
Crossing indifference curves



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Status Quo Bias

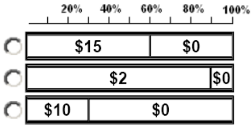
- A preference for whatever is the current situation
- Already described one example [Madrian and Shea 2000]
- But this could be down to transaction costs
- Here is an example with no transaction costs

Experimental Design: Setting the Status Quo

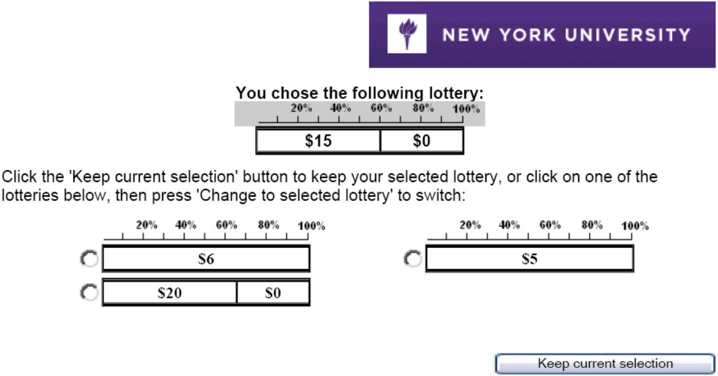
- Subjects make decisions in two stages
  - First stage: choose between 'target' lottery and two 'dummy' lotteries
  - Second stage: can either
    - Keep lotteries selected in first stage
    - Switch to one of the alternatives presented

NEW YORK UNIVERSITY

Please choose one of the lotteries below:

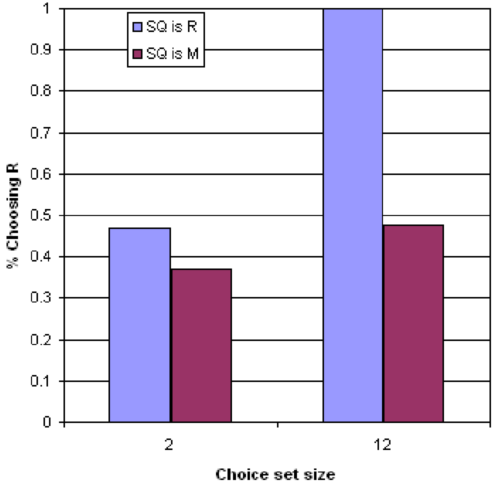


Continue


NEW YORK UNIVERSITY
You chose the following lottery:
20% 40% 60% 80% 100%
$15
$0
Click the 'Keep current selection' button to keep your selected lottery, or click on one of the lotteries below, then press 'Change to selected lottery' to switch:
20% 40% 60% 80% 100%
$6
$20
$0
20% 40% 60% 80% 100%
$5
Keep current selection

Experiment 2: Expansion

Results - Set {M,R,+ 10 inferior}



Prospect Theory: The Benchmark Model For Reference Dependent Choice

- Introduced by Kahneman and Tversky
  - For risky choice in 1979 [24,169 citations]
  - For riskless choice in 1991 [2,811 citations]
- Many many subsequent refinements, tests, applcations
- For an up to date guide: "Prospect Theory for Risk and Ambiguity" By Peter Wakker [2010]
  - 518pp (!)

- Three key elements
  - Decreasing sensitivity
  - Loss aversion
  - Probability weighting
- We will concentrate on the first two, as these concern reference dependence
- Probability weighting affects attitude towards risk

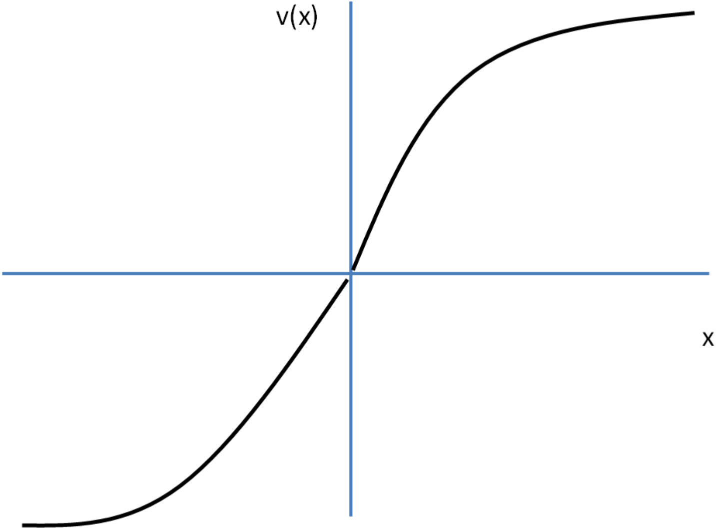
The Basic Set Up

- Assign utility to monetary gamble p with a reference level of income w
$$U(p, w) = \sum_{x \in X} p(x) v(x - w)$$
- v is a value function applied to the difference between a prize and the reference level of wealth
- Rather than assessing final wealth levels, assess gains and losses from w
- In full version of prospect theory $p(x)$ is replaced with some suitable probability weighting function

Diminishing Sensitivity

- Assumption: The marginal impact of gains and losses is decreasing as one moves away from the reference point
  - Provide a justification from psychophysics: this is true for light source, weights, etc,
- $v'(x)$ increasing for $x < 0$, and so $v''(x) > 0$
- $v'(x)$ decreasing for $x > 0$, so $v''(x) > 0$
- Implies that value function is concave in the gain domain and convex in the loss domain

Diminishing Sensitivity



Diminishing Sensitivity

- Automatically gives rise to the reflection effect
- But a very extreme assumption
  - People must be risk seeking in the loss domain
- Perhaps more realistic to insist that the risk aversion implied in the loss domain less than that implied in the gain domain

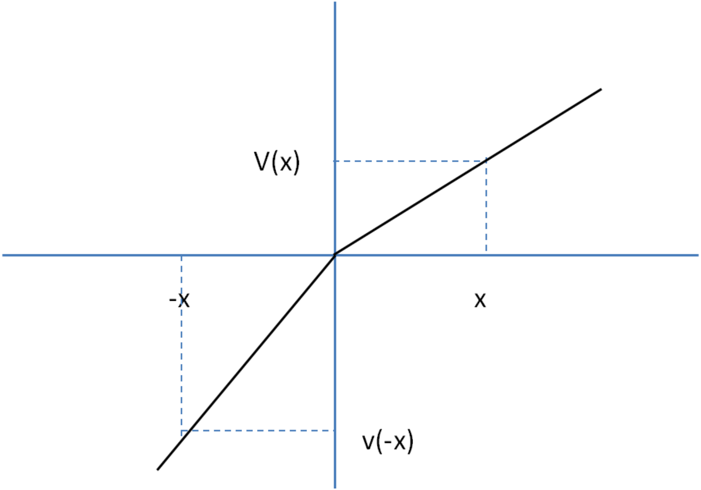
- One of *the* central assumptions in behavioral economics
- 'Losses loom larger than gains'
- "The aggrevation of losing $5 is greater than equivalent joy of gaining $5"
- Operationalized by assuming that, for any x

$$-v(-x) > v(x)$$

- One specific case

$$-v(-x) = \lambda v(x)$$

Loss Aversion



Loss Aversion

- What are the behavioral implication of this?
- None if we only see preferences for gambles consisting of all gains and gambles consisting of all losses
  - Expected utility numbers only definied up to a positive affine transformation
- Implication comes from comparing preferences for mixed gambles to those consisting of gains or losses
- In the case where $v(x) = \alpha x$ and $-v(-x) = \lambda v(x)$ risk neutral for gains an losses and risk averse for mixed gambles
- More generally, risk aversion for mixed gambles higher than one would expect having observed preferences in the gain and loss domain

Probability Weighting

- In the 1979 paper, KT introduced probability weighting
- Rather than

$$U(p, w) = \sum_{x \in X} p(x) v(x - w)$$

- they use

$$U(p, w) = \sum_{x \in X} \pi(p(x)) v(x - w)$$

- where $\pi(.)$ is a probability weighting function that tends to overweight small probabilities
- Captures Allais-style violations of expected utility

- Problem: models with probability weighting functions violate stochastic dominance
- Solution, replace probability function with rank dependent expected utility a la Quiggin 1982
  - The weight applied to prize x received with probability $p(x)$ dependeds on the rank of x in the support of p
- This is the difference between prospect theory and cumulative prospect theory [Tversky and Kahneman 1992]

A Note for the Decision Theorists

- You should be feeling a little uncomfortable about a model that plucks functional forms out of the air
- Means we don't fully understand it's behavioral implications
  - e.g. the problem with 'non-cumulative' prospect theory
- You should want an axiomatic representation of the model
- Beyond the scope of this course, but see Wakker and Tversky [1993]

Estimating Prospect Theory Parameters

- ‘Diminishing Sensitivity’ can be estimated directly from choice data
- 'Loss aversion’ is more tricky
  - Note that many papers measure loss aversion as λ such that

$$\frac{1}{2}x - \frac{1}{2}\frac{1}{\lambda}x \sim 0$$

  - i.e. assuming linear utility
- Abdelloui et. al. [2007] provide a non-parametric method, but requires a lot of choices
- Alternatively, make some parametric assumptions
- For example, Abdelloui et. al. [2008]

Abdelloui et al. [2008]

- Let G_i be the certainty equivalence of a lottery that pays off $x_i \geq y_i \geq 0$ with probability 0.5 each
- Assume that $v(x)$ in the gain domain is given by

$$v(x) = x^{\alpha} \backslash$$

- And p^+ is the probability assigned to x_i (the same for each gamble) then

$$G_i = \left(p^+ x_i^{\alpha} + \left(1 - p^+\right) y_i^{\alpha}\right)^{\frac{1}{\alpha}}$$

- Estimate α and p^+ using gambles in the gain domain
- Similary estimate β and p^- for gambles in the loss domain
- From choices over mixed gambles G_i, L_i, estimate λ from

$$p^+ G_i^{\alpha} + (1 - p^+) \lambda L_i^{\beta} = 0$$

Results

		Losses		
		Concave	Convex	Total
Gains	Concave	19	14	33
	Convex	9	5	14
	Total	28	19	47

Table 6 Estimation results

	Power estimate gains	Power estimate losses	Loss aversion coefficient
Median	0.86	1.06	2.61
IQR	0.66–1.08	0.92–1.49	1.51–5.51