Risk Preferences

PROSPECT THEORY IV:

Loss aversion, Probability weighting

EE416 SEM2/2019

Status Quo Bias

(coined by Samuelson and Zeckhauser (1988))

- The tendency of people to remain at the status quo even when it is in their interest to change what they are doing.
- Examples:
  - Failure to sell stocks when the market tanks because people do not want to admit to losses
  - Failure to adopt new technology and accept changes in production methods because the existing skills and knowledge become worthless
  - Failure to change saving plan for retirement
  - Staying in a bad relationship too long The failure to react to price changes
- An alternative became significantly more popular when it was designated as the status quo.

Status Quo Bias
(coined by Samuelson and Zeckhauser (1988))

- Samuelson and Zeckenhauser (1988) discuss four potential causes for the status-quo bias:
  - (1) Transition costs, which make the deviation from the status quo costly in itself;
  - (2) Uncertainty in the decisions situation, which requires costly effort to investigate alternatives and their benefits (search and decision-making cost). This might deal with limited cognitive capacity. To make a change is harder than staying the same;
  - (3) Cognitive misperceptions like loss aversion, endowment effect, anchoring or bounded rationality;
  - (4) Psychological commitment due to perceived sunk costs or other resource investments(Sunk-cost fallacy) or due to regret avoidance.

- Loss aversion is a powerful conservative force that favors minimal changes from the status quo.

The Sunk Cost Fallacy

- Normative economic theory indicates that costs incurred in the past are irrelevant for future marginal payoffs, i.e. sunk costs must be ignored.
- The sunk-cost fallacy (bias) is the irrational behavior of ”throwing good money after bad,” i.e. once found on a course of action to which they committed an investment (e.g. time, money, effort), people continue to stay on that course of action and invest even more resources despite it being unprofitable(Arkes & Blumer, 1985).
- The larger the sunk cost, the stronger the bias, and cognitive ability does not alleviate the bias(Haita-Falah, 2017)

The Sunk Cost Fallacy

- Examples:
  - Students stay with a research topic way too long before switching to another one
  - Continued investment into engineering a new product that has become a black hole for money with no production in sight
  - Continued marketing expenditures on a product that consumers hate

The Sunk Cost Fallacy

- Explanation: Loss aversion. Risk-seeking behavior in the loss domain is responsible for the escalation on an initial investment.
- Other explanation: Cognitive dissonance(mental discomfort from inconsistency of ideas)
  - The best way one can justify past decisions is by continuing to pour resources into a failing course of action.

PROBABILITY WEIGHTING

PROSPECT THEORY, EE416
SEM2/2019

Recall: Prospect theory

- A prospect can be written as $(x, p; y, q)$ with $p + q \leq 1$.
- Note: $p + q < 1$ implies prospect yields 0 with probability $1 - p - q$.

- A person evaluates a prospect $(x, p; y, q)$ according to the functional

$$V(x, p; y, q) = \pi(p)v(x) + \pi(q)v(y)$$

Probability vs The weighting of probability

- The decision weights that people assign to outcomes are not identical to the probabilities of these outcomes.

- The weighting is an operation of system 1.

- We have different sensitivity to change in probability depending on the level of probability being considered.
- Psychological effect: possibility effect and certainty effect

The possibility effect: 0% → 5%

- The move from a 0% chance to a 5% possibility of winning a prize or losing something transform the situation.
- It creates a possibility that did not exist earlier.
- The influence we give to the move from 0% probability to 5% illustrates the possibility effect.
- The weights reflect the hope of winning or the worry of losing.

The possibility effect: 0% → 5%

- The possibility effect causes highly unlikely outcomes to be weighted disproportionately more than they "deserve" (if we evaluate the change in probability objectively).
- Overweighting of small probabilities increases the attractiveness of both gambles and insurance policies.

The certainty effect: 95% → 100%

- Outcomes that are almost certain are given less weight than their probabilities justifies.

Example from the work of Kahneman and Tversky

Prob(%) of winning a gamble	0	1	2	5	10	20	50	80	90	95	98	99	100
Decision weight	0	5.5	8.1	13.2	18.6	26.1	42.1	60.1	71.2	79.3	87.1	91.2	100

- The decision weights are identical to the corresponding probabilities at the extremes: the impossible and the sure thing.
- The decision weights depart sharply from probabilities near these points.
- At 2%, the rare event is overweighted by a factor of 4.
- At 98%, a 2% risk of not winning the prize reduces the weight by 13% , from 100 to 87.
- Inadequate sensitivity to intermediate probabilities.
- To note, sometimes the very small probabilities get ignored.

Probability Weighting in Kahneman & Tversky (1979)

- They suggest that the probability-weighting function $\pi(p)$ will have several features such as:
  - Overweighting of small probabilities $\pi(p) > p$,
  - Underweighting of large probabilities $\pi(p) < p$,
  - Subcertainty $\pi(p) + \pi(1 - p) < 1$,
  - A discontinuity at the endpoints.

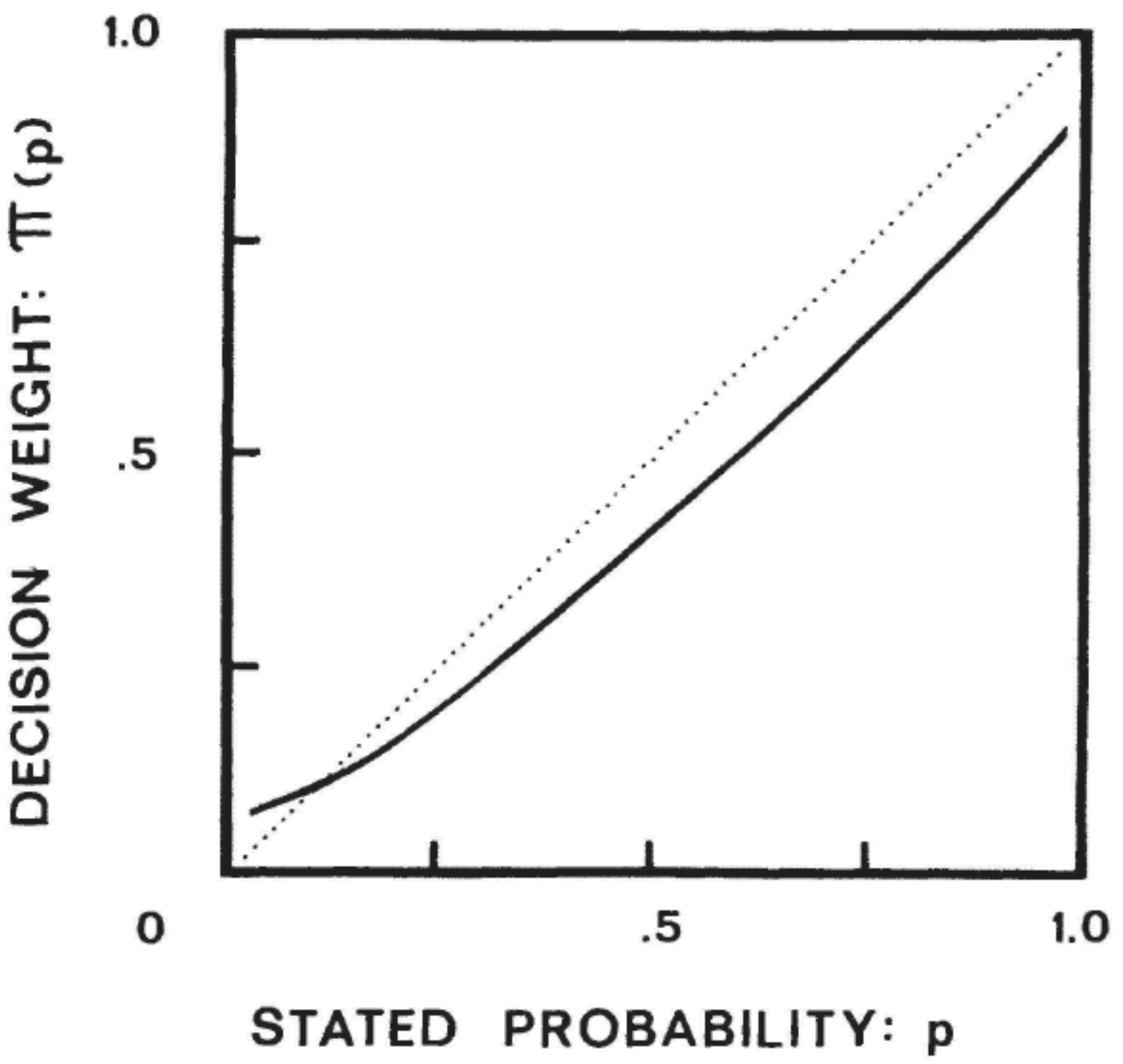


FIGURE 4.—A hypothetical weighting function.

A Simple Functional Form

- $\pi(p) = \begin{cases} 0 & if\ p = 0 \\ \alpha + \beta p & if\ p \in (0,1) \\ 1 & if\ p = 1 \end{cases}$
- If $\alpha > 0$ and $\beta < 1 - 2\alpha$, then this functional form generates overweighting of small probabilities, underweighting of large probabilities, subcertainty, and a discontinuity at the endpoints.

Inverse S-Shaped Probability Weighting Functions

- In the ensuing years, people started to eliminate the discontinuity at the endpoints by assuming an inverse S-shaped probability weighting function.
- Indeed, people posited specifc, parametrized functional forms. Two prominent examples:

Inverse S-Shaped Probability Weighting Functions

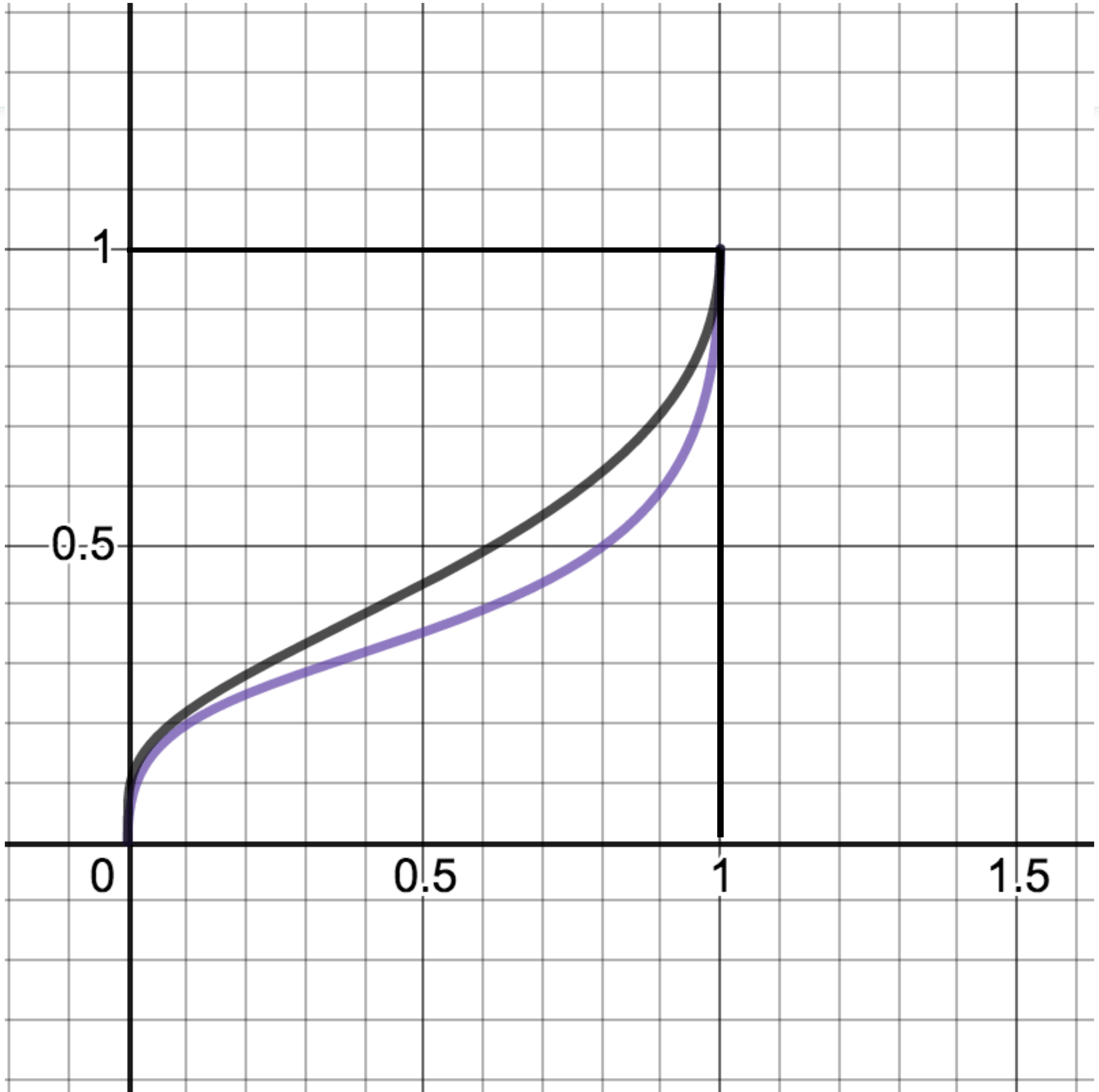
- Tversky & Kahneman (JRU 1992) suggest

$$\pi(p) = \frac{p^{\gamma}}{(p^{\gamma} + (1-p)^{\gamma})^{1/\gamma}} \qquad for\ some\ \gamma \in (0.279,1)$$

- Prelec (ECTA 1998) suggests

$$\pi(p) = \exp(-(-lnp)^{\alpha}) \qquad for\ some\ \alpha \in (0,1)$$

Inverse S-Shaped Probability Weighting Functions



$$\pi(p) = \exp(-(-lnp)^{0.5})$$

$$\pi(p) = \frac{p^{0.5}}{(p^{0.5} + (1-p)^{0.5})^{1/0.5}}$$

https://www.desmos.com/

Differential Weighting for Gains vs. Losses

- Tversky & Kahneman (JRU 1992) propose differential probability weighting for gains and losses.
- Weights on losses and weights on gains derived from two separate probability-weighting functions π^{-} and π^{+} .

Economic Applications

- Barberis & Huang (AER 2008): Rank-dependent probability weighting yields a preference for assets with positively skewed returns.
- Barberis (MS 2011): Rank-dependent probability weighting can generate a preference for casino gambling despite negative expected returns because certain gambling strategies can generate an asset with positively skewed returns.

Economic Applications

- Bruhin, Fehr-Duda, & Epper (ECTA 2010) Experimental data on certainty equivalents for simple lotteries. Estimate a mixture model of cumulative prospect theory, and conclude that roughly 20% of subjects are essentially expected value maximizers while roughly 80% exhibit significant non-linear probability weighting (and very little curvature in value function).

Economic Applications

- Snowberg & Wolfers (JPE 2010) Data from horse races on odds and probability of winning for different types of bets.
- Compare model with risk aversion vs. model of probability weighting, and conclude the latter better fits the data.

Probability weighting vs. Probability misperception

- We cannot distinguish probability weighting from probability misperception.

The Fourfold pattern of risk preferences: The core achievement of prospect theory

	GAINS	LOSSES
HIGH PROBABILITY	95% chance to win $10,000 Risk averse + Underweighting Fear of disappointment **RISK AVERSE** Accept unfavorable settlement Ex: refusing low-risk high return business opportunity	95% chance to lose $10,000 Risk seeking + Underweighting Hope to avoid loss **RISK SEEKING** Reject favorable settlement Ex: taking desperate gambles for a small hope of avoiding large loss
LOW PROBABILITY	5% chance to win $10,000 Risk averse + Overweighting Hope of large gain **RISK SEEKING** Reject favorable settlement Ex: buying lottery tickets	5% chance to lose $10,000 Risk seeking + Overweighting Fear of large loss **RISK AVERSE** Accept unfavorable settlement Ex: buying insurance policies

Choices are:
risk averse if sure thing(corresponding to the expected value) is preferred,
risk seeking if the gamble is preferred.

The Fourfold pattern of risk preferences

- For intermediate/large probabilities, risk-averse behavior over gains and risk-loving behavior over losses.
- For small probabilities, risk-loving behavior over gains and risk-averse behavior over losses.