# Risk Preferences

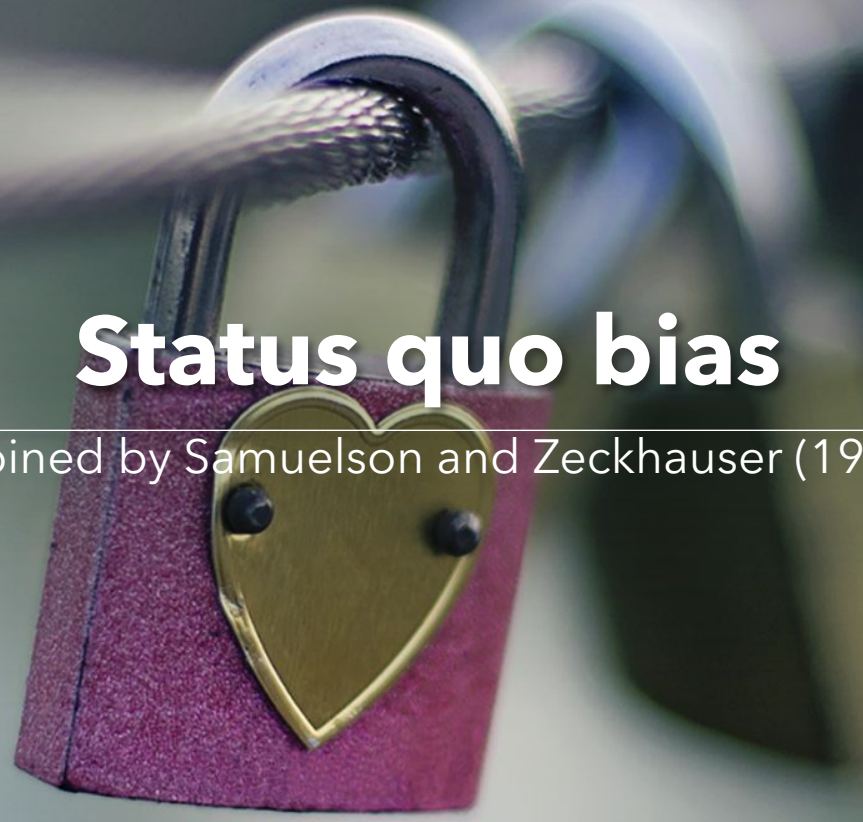
## PROSPECT THEORY IV:

Probability weighting

EE416 SEM1/2020

Can loss aversion help explain....?

**The tendency of people to remain at the status quo even when it is in their interest to change what they are doing.**



# Status quo bias

(coined by Samuelson and Zeckhauser (1988))

# Status Quo Bias

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- 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 decision 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.

Can loss aversion help explain....?

# The Sunk Cost Fallacy

# The Sunk Cost Fallacy

- Normative economic theory indicates that costs incurred in the past are _____for future _____payoffs

- Sunk costs must be_____.

# The Sunk Cost Fallacy

- 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 Sunk Cost Fallacy

- 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. _____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

# 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 $p$ vs The weighting of probability $\pi(p)$

- 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.

# Probability vs The weighting of probability

- We have _____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_____.
- 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 _____ _____more than they "deserve" (if we evaluate the change in probability objectively).

- Overweighting of small probabilities increases the attractiveness of both_____.

# The certainty effect: 95% → 100%

- Outcomes that are almost certain are given_____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.

# 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 |

- At 2%, the rare event is overweighted by a factor of_____.
- At 98%, a 2% risk of not winning the prize reduces the weight by_____ , from 100 to 87.

# 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 |

- Inadequate_____ to _____ 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_____,
  - Underweighting of large probabilities_____,
  - Subcertainty_____,
  - A discontinuity at the endpoints.

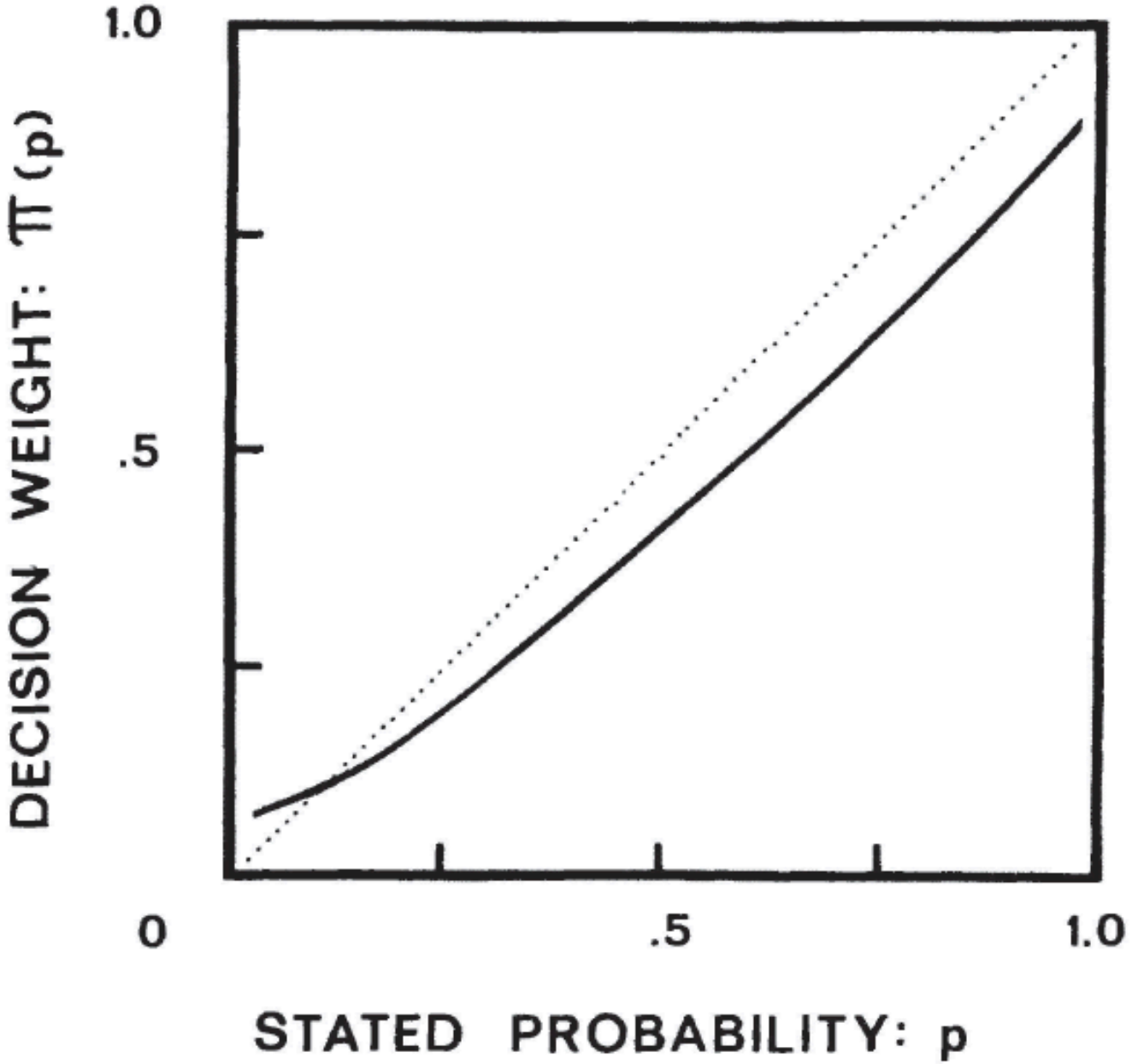



FIGURE 4.—A hypothetical weighting function.

# 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 $0 < \alpha < 1$ 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

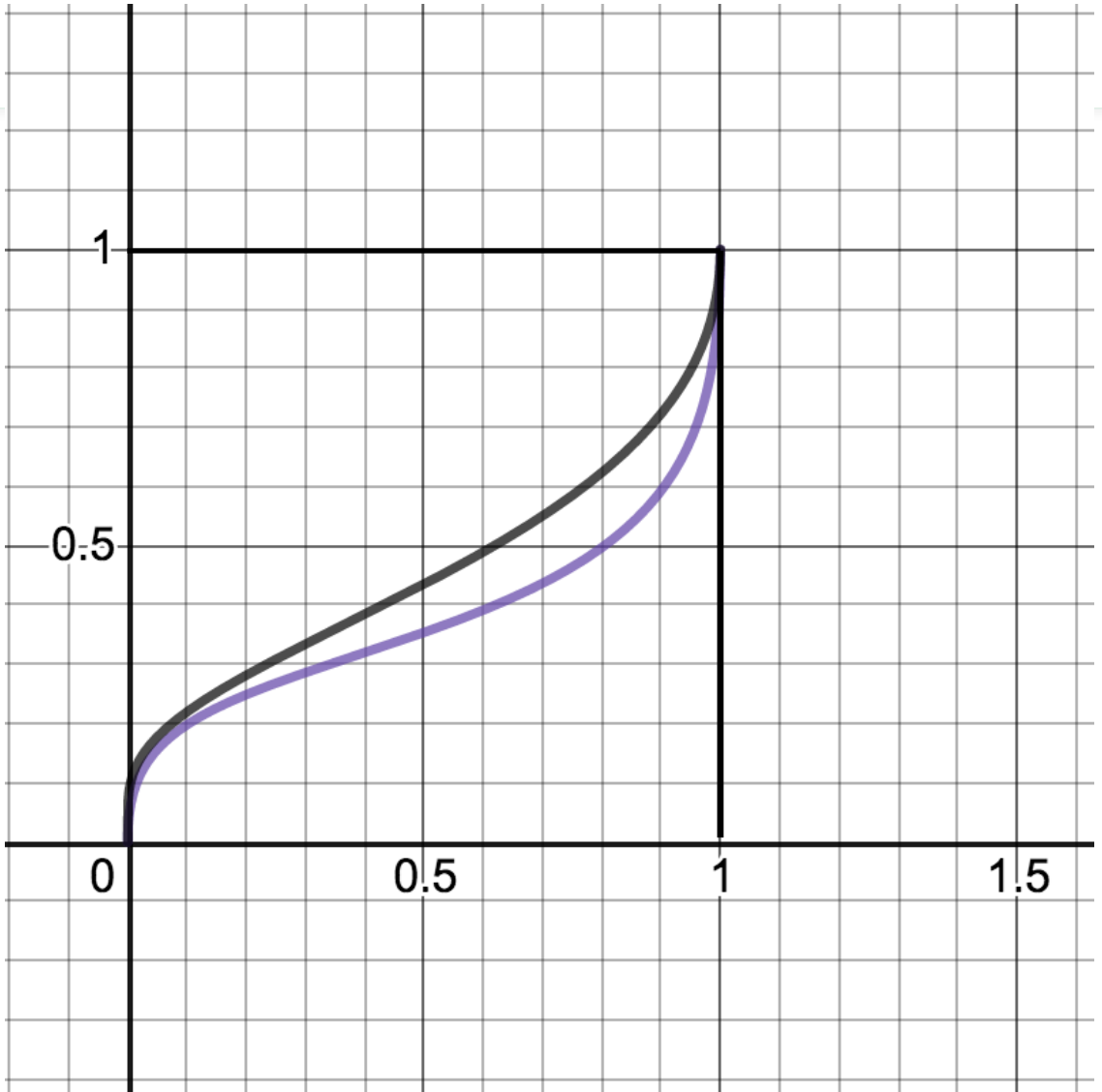
- Tversky & Kahneman (JRU 1992) suggest

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

- 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 $\pi^-$ and $\pi^+$ .

# 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.

# Probability weighting vs. Probability misperception

- We cannot distinguish probability weighting from probability misperception.