Loss Aversion: A Possibility-Impossibility Result

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About Loss Aversion (LA)

- The notion that "Losses loom larger than gains".
- Already mentioned by Adam Smith (1759).
- Formalized in the Original Prospect Theory paper (OPT; Kahneman and Tversky, 1979).
- Thaler (2017): "One of the most powerful findings of behavioural economics is loss aversion."
- Theoretically, LA transforms basic utility, u (Shalev 2000, Köbberling and Wakker 2005) and is a parameter λ.
- Then

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

- where λ captures the size of loss aversion.
- Also known as the "Gain-Loss utility" form.

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Theory of Loss Aversion (TLA) and Contributions

- Derive **endogenously**, a loss aversion index that is of the Gain-Loss utility form.
- Provides a preference foundation that extends OPT.
- No violation of FOSD even with **general lotteries**.
- Behaviourally: decision maker has primary and secondary concerns:
  - Primary: **overall probability** of gaining or losing (Payne 2005).
  - Secondary: conditional distribution over gains and losses.
- Example: Meeting targets.
- An **impossibility result**: Continuity in outcomes is incompatible with probability weighting.
  - Probability distortions: Overweight small and underweight high probabilities.
  - EU with a kink at the reference point.

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Impossibility Result: An Example

- Consider the following choices:

$$0 \text{ vs lottery A} : (0.05 : -25, 0.9 : 0, 0.05 : 1000)$$
$$0 \text{ vs lottery B} : (0.05 : -25, 0.85 : \varepsilon^-, 0.05 : 0, 0.05 : 1000)$$

When ε^- approaches zero:

- Preference can still reverse because lottery B has a high probability of obtaining a (very small) loss.
- Inconsistent behaviour can occur near the reference point.
- Probability weighting alone cannot explain such preference reversal.
- TLA does not necessitate continuity in outcomes but only in probabilities.

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The Theory of Loss Aversion

- For a simple lottery $S = (p^- : x^-, p_0 : 0, p^+ : x^+)$
- $TLA(S) = w^-(p^-)U(x^-) + w^+(p^+)U(x^+)$
- Utility assigns 0 to the reference point and is a ratio scale.
- Preference over lotteries: complete, transitive, monotone w.r.t. FOSD, continuous in probabilities.
  - **Consistency** for overall probability of gains (losses).
- Provides preference foundation that extends OPT.
  - $OPT(S) = w(p^-)U(x^-) + w(p^+)U(x^+)$.
  - Probability weighting is sign dependent in TLA.

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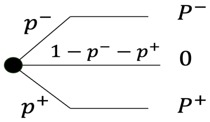
TLA General form

- For simplicity let us assume (at least) five outcomes, ranked against the reference point, 0: $x_{-2} \prec x_{-1} \prec 0 \prec x_1 \prec x_2$.
- Borrows the treatment of general lotteries from Disappointment Aversion (Gul, 1991).
- Lottery P can be represented as:



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- $TLA(P) = w^-(p^-)\Lambda(EU(P^-)) + w^+(p^+)\Lambda(EU(P^+))$
- *TLA* is more similar to other PT-like models.

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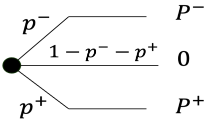

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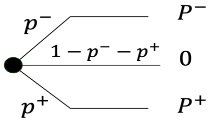

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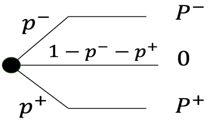

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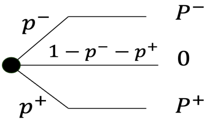

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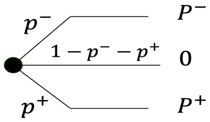

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TLA and Loss aversion Index

- $TLA(P) = w^{-}(p^{-})\Lambda(EU(P^{-})) + w^{+}(p^{+})\Lambda(EU(P^{+}))$
- $U(x) = \Lambda[u(x)]$ where Λ is the Loss Aversion Index that transform basic utility, u (strictly monotone in preference).

$$U(x) = \begin{cases} \lambda u(x_{i^-}) \\ u(x_{i^+}) \end{cases}$$

- Preference over lotteries: complete, transitive, monotone w.r.t. FOSD, continuous in probabilities.
  - **Consistency** for overall probability of gains (losses)
  - von Neumann–Morgenstern (vNM) independence for gains (losses).

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- $U(x) = \Lambda[u(x)]$ where Λ is the Loss Aversion Index that transform basic utility, u (strictly monotone in preference).

$$U(x) = \begin{cases} \lambda u(x_{i^-}) \\ u(x_{i^+}) \end{cases}$$

- Preference over lotteries: complete, transitive, monotone w.r.t. FOSD, continuous in probabilities.
  - **Consistency** for overall probability of gains (losses)
  - von Neumann–Morgenstern (vNM) independence for gains (losses).

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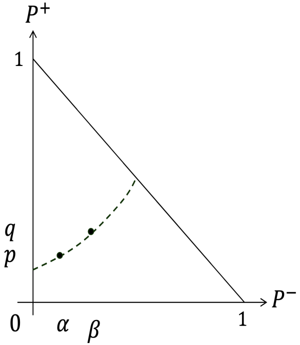
Consistency for general probability of losing

$(\alpha : P^-, p : P^+) \sim (\beta : P^-, q : P^+)$



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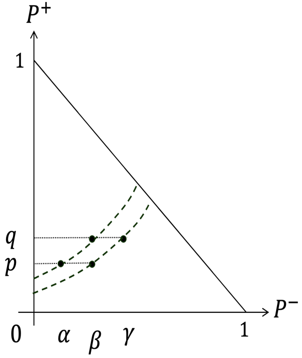

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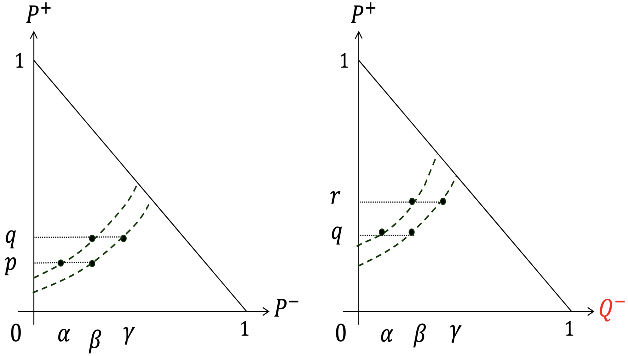

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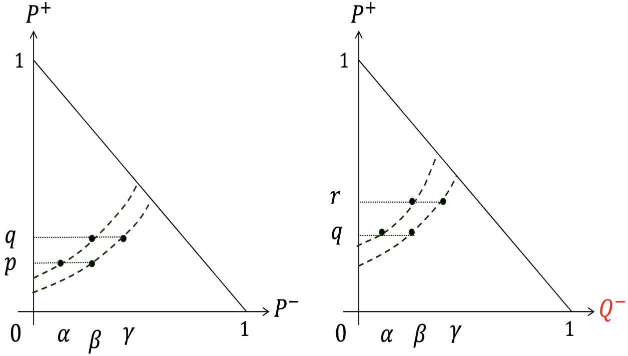

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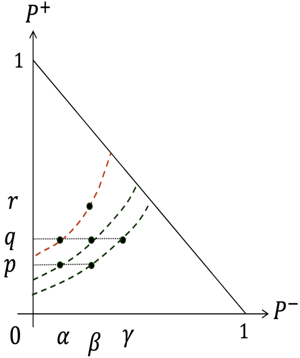

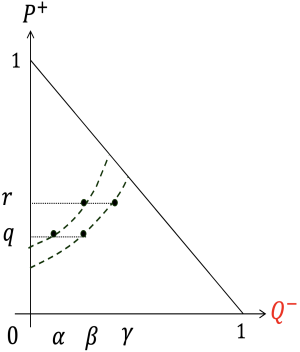

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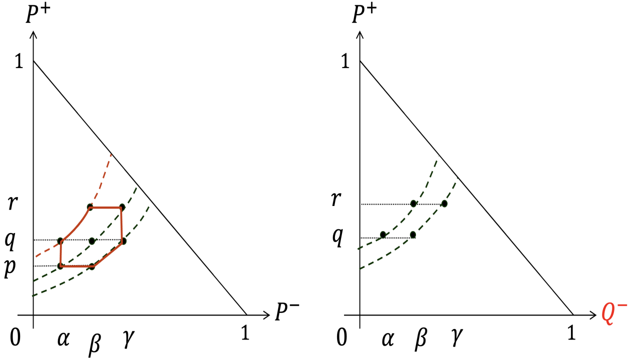

- implies the hexagon condition (Wakker, 1989) that gives additive separability.

A constraint by Continuity in outcomes

- For TLA, continuity in outcomes is not required, just like the vNM-approach for EU.
- One can demand, continuity in outcomes for standard EU: utility is continuous.
- Not for TLA $\rightarrow$ an **impossibility result**.
- The gain-loss utility in TLA can be discontinuous **at the reference point**.
  - Continuity of U for losses and separately for gains is possible.
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Our take...

- Trade-off between empirical realism (loss aversion/probability weighting) and the technical property of continuity.

- For the flexibility that TLA offers, giving up continuity of utility at the reference point, does not seem a high price.

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