Intergenerational Risk Sharing and Prospect Theory

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Research question

- Welfare gains from intergenerational risk sharing
  - Collective db en dc systems
- Prospect theory
  - Matches the data better than expected utility theory
  - 2nd Nobel Prize for prospect theory
- The missing piece
  - This paper aims to fill this gap

Structure presentation

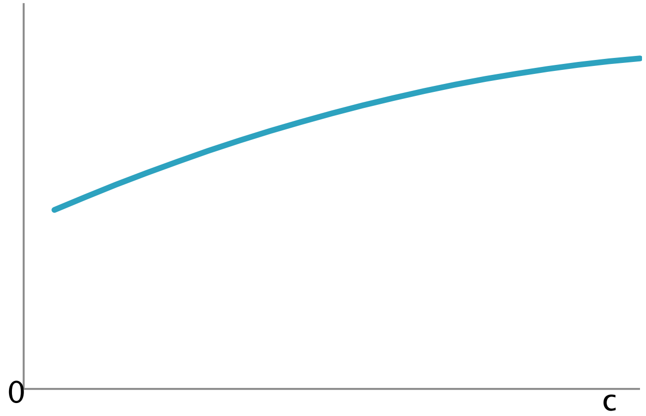
- 1 How does prospect theory relate to expected utility theory?
  - Graphical analysis
- 2 Assessment of gains from risk sharing
  - 2-state model
  - Multi-state model
  - Probability weighting (*)
- 3 Optimal risk sharing policies (PAYG)
  - Expected utility theory
  - Prospect theory: adverse shocks
  - Prospect theory: positive shocks
  - Welfare gains

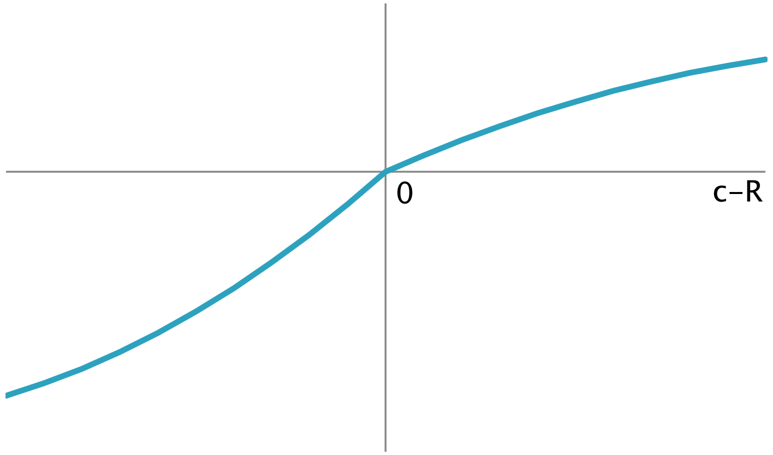
Structure presentation

- 4 Optimal risk sharing policies under prospect theory (Funded)
  - Expected utility theory
  - Prospect theory: adverse shocks, no period $t+1$ uncertainty (*)
    - Adding period $t+1$ uncertainty (*)
  - Prospect theory: positive shocks, no period $t+1$ uncertainty (*)
    - Adding period $t+1$ uncertainty (*)
  - Welfare gains (*)

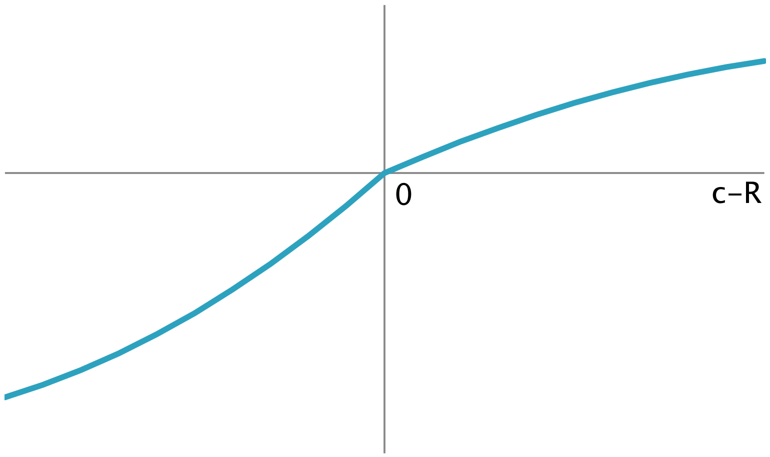
- Conclusions

1 How does prospect theory relate to expected utility theory?



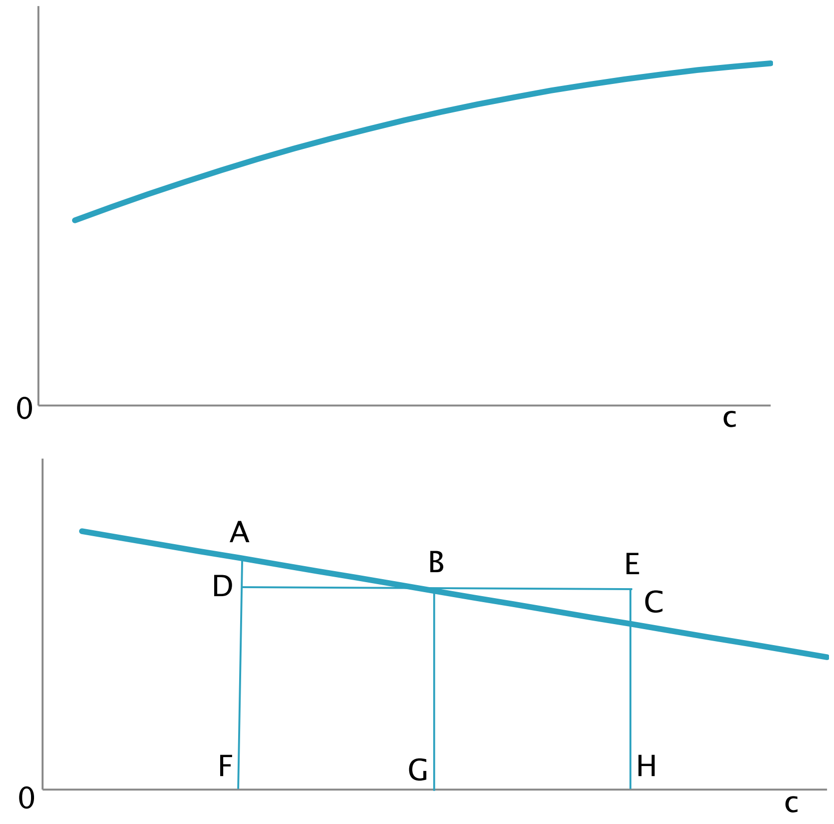


How does prospect theory relate to expected utility theory?

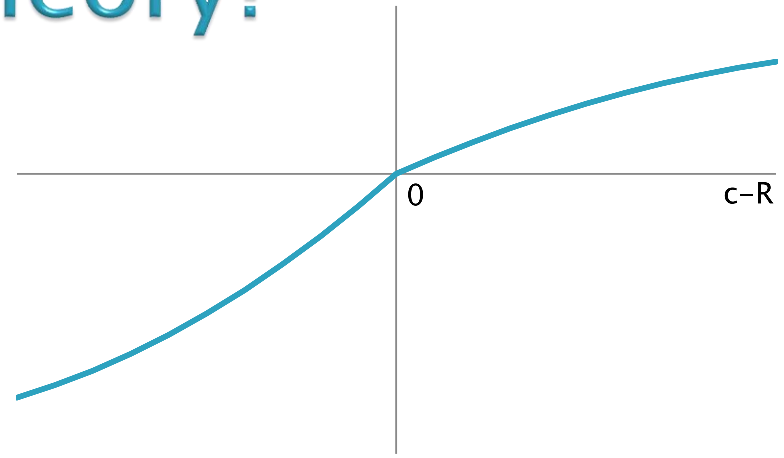


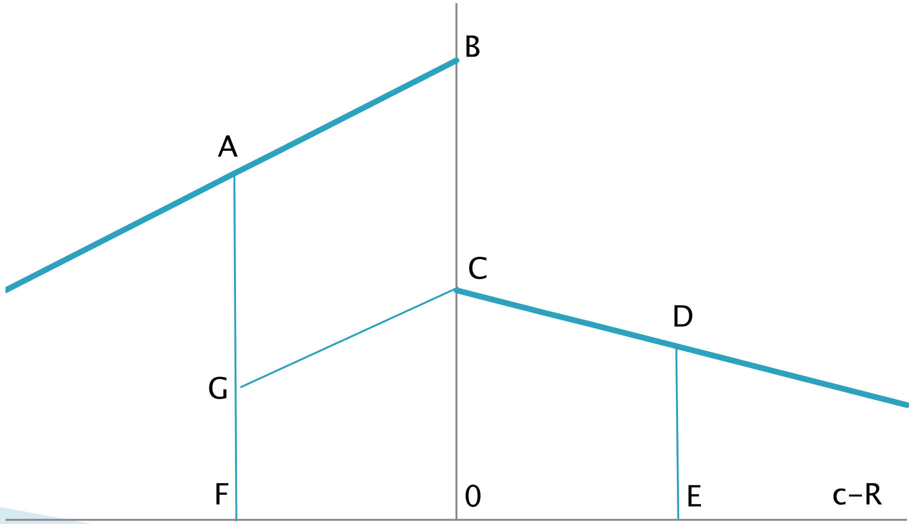
- Reference position
- Convex–concave utility
- Loss aversion
- Probability weighting

How does prospect theory relate to expected utility theory?



How does prospect theory relate to expected utility theory?





2 Assessment of gains from risk sharing: 2-state model

- Two states
  - A good (G) and a bad (B) state
  - Consumption in G: 1.1
  - Consumption in B: 0.9
- Welfare measured by certainty-equivalent of consumption
- EUT:
  - CRRA = 2
- PT: Tversky & Kahneman (1992):
  - Loss aversion index = 2.25
  - Concavity parameters =0.88
  - Reference position

Assessment of gains from risk sharing: 2-state model

Table 1: Welfare loss due to consumption risk under prospect and expected utility theory - the case of a two-state consumption distribution

Simulation		Υ_{EU}	Υ_{PT}
(1)	Benchmark values	0.010	0.023
(2)	As in (1), but $\gamma_{EU} = -0.2$	0.006	0.023
(3)	As in (1), but $\gamma_{EU} = -4.0$	0.024	0.023
(4)	As in (1), but $\lambda = 1.5$	0.010	0.013
(5)	As in (1), but $\lambda = 3.0$	0.010	0.029
(6)	As in (1), but $\gamma_{PT}^{-} = 1.0$	0.010	0.037
(7)	As in (1), but $\gamma_{PT}^{-} = \gamma_{PT}^{+} = 1.0$	0.010	0.028
(8)	As in (1), but $c_B = 0.99$, $c_G = 1.01$	0.000	0.002
(9)	As in (1), but $c_B = 0.95$, $c_G = 1.05$	0.003	0.012
(10)	As in (1), but $c_B = 0.8$, $c_G = 1.2$	0.040	0.047
(11)	As in (1), but $c_B = 0.7$, $c_G = 1.3$	0.090	0.070

Assessment of gains from risk sharing: multi-state model

- Constructed income distribution:
  - Lognormal, $E(y)=4.7$; $\sigma_y=2.1$
- Welfare measure and parameterization the same as before

Assessment of gains from risk sharing: multi-state model

Table 2: Welfare loss due to consumption risk under prospect and expected utility theory - the case of a multi-state consumption distribution

Simulation		Υ_{EU}	Υ_{PT}
(1)	Benchmark values	0.162	0.082
(2)	As in (1), but $\gamma_{EU} = -0.2$	0.101	0.082
(3)	As in (1), but $\gamma_{EU} = -4.0$	0.357	0.082
(4)	As in (1), but $\lambda = 1.5$	0.162	0.050
(5)	As in (1), but $\lambda = 3.0$	0.162	0.099
(6)	As in (1), but $\gamma_{PT}^{-} = 1.0$	0.162	0.101
(7)	As in (1), but $\gamma_{PT}^{-} = \gamma_{PT}^{+} = 1.0$	0.162	0.093
(8)	As in (1), but $\sigma = 0.3$	0.086	0.057
(9)	As in (1), but $\sigma = 0.15$	0.022	0.028

Probability weighting

$$\pi^-(c(i)) = \Pi^-(c(i)) - \Pi^-(c(i-1))$$

$$\Pi^-(c(i)) = \frac{P^-(c(i))^{\epsilon^-}}{\left(P^-(c(i))^{\epsilon^-} + (1 - P^-(c(i)))^{\epsilon^-}\right)^{1/\epsilon^-}}$$

$$P^-(c(i)) = \frac{i + n^- + 1}{n^-}$$

$$\pi^+(c(i)) = \Pi^+(c(i)) - \Pi^+(c(i-1))$$

$$\Pi^+(c(i)) = \frac{P^+(c(i))^{\epsilon^+}}{\left(P^+(c(i))^{\epsilon^+} + (1 - P^+(c(i)))^{\epsilon^+}\right)^{1/\epsilon^+}}$$

$$P^+(c(i)) = \frac{i}{n^+}$$

Probability weighting

- Concavity parameters (Benartzi & Thaler, 1995):
  - $\varepsilon^{-}=0.69$; $\varepsilon^{+}=0.61$
- Welfare measure and parameterization the same as before

Probability weighting

Table 3: Welfare loss due to consumption risk under prospect theory - the role of probability weighting

Simulation		Υ_{PT}	$\hat{\Upsilon}_{PT}$
(1)	Benchmark values	0.082	0.086
(2)	As in (1), but $\lambda = 1.5$	0.050	0.037
(3)	As in (1), but $\lambda = 3.0$	0.099	0.113
(4)	As in (1), but $\gamma_{PT}^{-} = 1.0$	0.101	0.128
(5)	As in (1), but $\gamma_{PT}^{-} = \gamma_{PT}^{+} = 1.0$	0.093	0.109
(6)	As in (1), but $\sigma = 0.3$	0.057	0.061
(7)	As in (1), but $\sigma = 0.15$	0.028	0.030
(8)	As in (1), but $\epsilon^{-} = 0.85$, $\epsilon^{+} = 0.80$	0.082	0.079
(9)	As in (1), but $\epsilon^{-} = 0.55$, $\epsilon^{+} = 0.40$	0.082	0.067

2-3 Measurement of welfare gain from intergenerational risk sharing

- Risk sharing ≠ risk reduction
- Risk sharing affects people differently at least twice in their lifetime
- Are pension funds willing to share risks? Will they always use the option to do so?

3 Optimal risk sharing policies (PAYG)

- PAYG scheme
- Two generations, the young and the old
- Expected utility theory

- Risk sharing according to social welfare weights
  - If weights are equal, risk sharing implies consumption smoothing
  - Applies to all shocks, positive and negative

Optimal risk sharing policies (PAYG)

- Prospect theory
- Adverse shock

- No risk sharing! Optimal policies let one of the two generations bear the whole shock
  - Convex losses part of the utility function implies risk-seeking behaviour
- Old or young, indifferent

Optimal risk sharing policies (PAYG)

- Prospect theory
- Positive shock

- Full risk sharing
  - Gains part of the utility function is concave

Assessment of gains from risk sharing: PAYG scheme

Table 4: Welfare loss under expected utility and prospect theory - optimal policies for a PAYG pension scheme

Simulation		$\tilde{\Upsilon}_{EU}$	$\tilde{\Upsilon}_{PT}$
(1)	Benchmark values	0.024	0.006
(2)	As in (1), but $\gamma_{EU} = -0.2$	0.001	0.006
(3)	As in (1), but $\gamma_{EU} = -4.0$	0.148	0.006
(4)	As in (1), but $\lambda = 1.5$	0.024	0.008
(5)	As in (1), but $\lambda = 3.0$	0.024	0.004
(6)	As in (1), but $\sigma = 0.3$	0.012	0.004
(7)	As in (1), but $\sigma = 0.15$	0.003	0.002
(8)	As in (1), but $\epsilon^{-} = 0.69$ and $\epsilon^{+} = 0.61$		

4 Optimal risk sharing policies (Funded)

- Funded scheme
- Two generations, the young and the unborn (born next period)
- Expected utility theory

- Risk sharing according to social welfare weights
  - If weights are equal, risk sharing implies consumption smoothing
  - Applies to all shocks, positive and negative

Optimal risk sharing policies (Funded)

- Prospect theory
- Adverse shock
- Assumption: no period $t + 1$ uncertainty

- No risk sharing! Optimal policies let one of the two generations bear the whole shock
  - Convex losses part of the utility function implies risk-seeking behaviour
- Young or future generation, indifferent

Optimal risk sharing policies (Funded)

- Add period $t+1$ uncertainty

Optimal risk sharing policies (Funded)

- Prospect theory
- Positive shock
- Assumption: no period $t+1$ uncertainty

- Full risk sharing
  - Gains part of the utility function is concave

Optimal risk sharing policies (Funded)

- Add period $t + 1$ uncertainty

Conclusions

(%)	2-state distribution	Multi-state distribution	Probability weighting	Optimal policies (PAYG)
Expected utility theory	1.0	16.2	16.2	2.4
Prospect theory	2.3	8.2	8.6	0.6

Conclusions

- Prospect theory implies smaller welfare gains from intergenerational risk sharing
  - Welfare gains first-order under PT
  - Result does not hinge on diminished sensitivity or probability weighting
  - Optimal pension policies share only positive shocks
    - Applies to PAYG and funded schemes